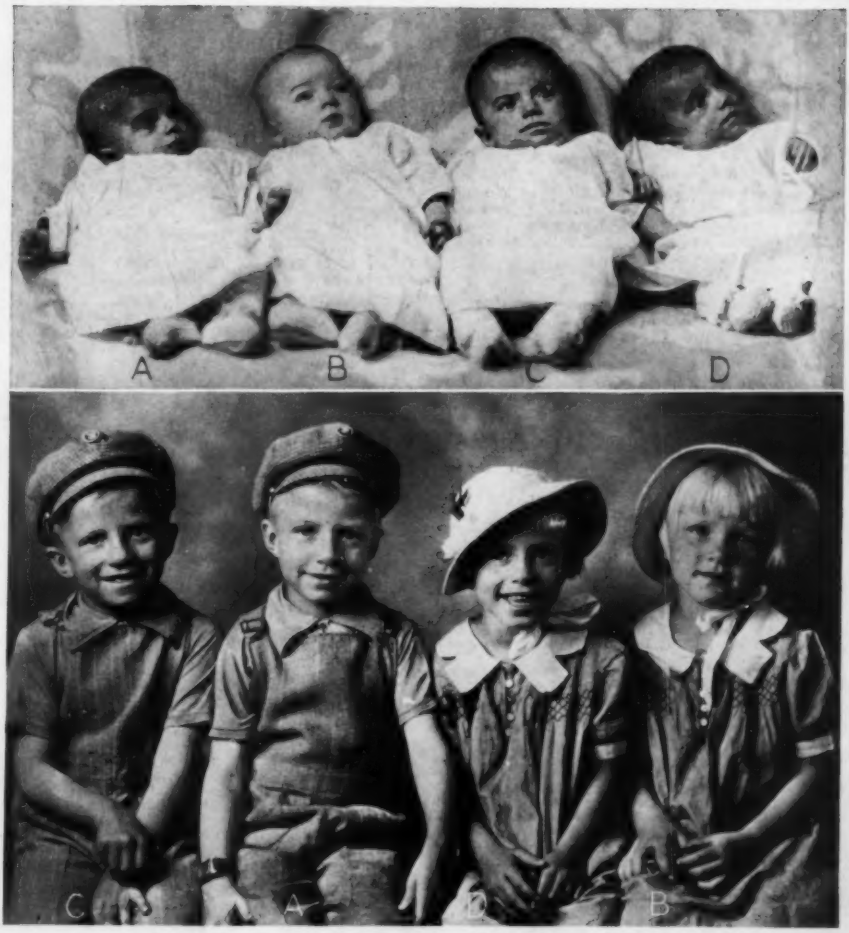
PEARL

The Journal of HEREDITY



HOW THE SCHENSE QUADS GROW UP

(SEE PAGE 249)

The Platinum Fox — a Mutation "in the Money"

Family Values in a Changing World

VOLUME 30 JUNE, 1939 NUMBER 6

The American Genetic Association

An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks

DAVID FAIRCHILD, President — Vice-President, W. E. CASTLE — Secretary, C. E. LEIGHTY

Treasurer, J. H. KEMPTON

Legal Advisor, STANTON C. PEELLE

EDITORIAL BOARD

Managing Editor, ROBERT C. COOK

M. DEMEREC — R. R. GRAVES — L. C. DUNN

H. J. MULLER — GEORGE M. DARROW — PAUL POPENOE

Members of the Council are ex-officio members of the Executive Board

COUNCIL

W. E. CASTLE, Emeritus Professor of Genetics, Harvard University, and Research Associate of the Carnegie Institution of Washington.

LEON J. COLE, Professor of Genetics, University of Wisconsin.

O. F. COOK, Bionomist in Charge of Breeding Investigations, U. S. Department of Agriculture.

DAVID FAIRCHILD, Agricultural Explorer, U. S. Department of Agriculture.

HARRY V. HARLAN, Senior Agronomist in Charge of Barley Investigation, U. S. Department of Agriculture.

SAMUEL J. HOLMES, Professor of Zoology, University of California, Berkeley, California.

J. H. KEMPTON, Bureau of Plant Industry, U. S. Department of Agriculture.

W. V. LAMBERT, Geneticist, Animal Husbandry Division, U. S. Dept. of Agriculture, Washington, D. C.

C. E. LEIGHTY, Agronomist in Charge of Dry Land Agriculture, U. S. Department of Agriculture.

N. D. C. LEWIS, Director, New York State Psychiatric Institute and Hospital, New York City.

MARCUS M. RHOADS, Geneticist, Office of Cereal Crops and Diseases, U. S. Department of Agriculture, Washington, D. C.

SEWALL WRIGHT, Professor of Zoology, University of Chicago.

ADVISORY COMMITTEE

W. S. ANDERSON, Genetics Department, University of Kentucky, Lexington, Kentucky.

E. B. BABCOCK, Genetics Department, University of California, Berkeley, California.

E. A. BESSEY, Professor of Botany, Michigan State College, Lansing, Michigan.

A. F. BLAKESLEE, Plant Geneticist, Carnegie Institution, Cold Spring Harbor, New York.

W. E. BRYAN, Professor of Plant Breeding, University of Arizona, Tucson, Arizona.

C. B. DAVENPORT, Carnegie Institution of Washington, Cold Spring Harbor, L. I., New York.

RUSSELL W. DUCK, Livestock Editor, *The Rural New Yorker*, Syracuse, N. Y.

R. A. EMERSON, Professor of Plant Breeding, Cornell University, Ithaca, New York.

C. P. GILLETTE, President, The Genetic Foundation, Fort Collins, Colorado.

C. M. GOETHE, Sacramento, California.

HARRISON R. HUNT, Professor of Zoology, Michigan State College, East Lansing.

H. S. JENNINGS, Professor of Zoology, Johns Hopkins University, Baltimore, Maryland.

D. F. JONES, Plant Breeder, Connecticut Agricultural Experiment Station, New Haven, Conn.

M. A. JULL, Senior Poultry Husbandman, U. S. Department of Agriculture, Washington, D. C.

F. B. LINFIELD, Director, Montana Experiment Station, Bozeman, Montana.

C. C. LITTLE, Director, Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine.

JAY L. LUSH, Professor in Animal Husbandry, Iowa State College, Ames, Iowa.

H. H. NEWMAN, Professor of Zoology, University of Chicago, Chicago, Ill.

T. S. PALMER, Expert in Game Conservation, U. S. Dept. of Agriculture, Washington, D. C.

JOHN H. PARKER, Professor of Agronomy, Kansas State College, Manhattan, Kansas.

JOHN W. SCOTT, Professor of Zoology, University of Wyoming, Laramie, Wyoming.

A. D. SHAMEL, Physiologist, U. S. Department of Agriculture, Riverside, California.

GEORGE H. SHULL, Professor of Biology, Princeton University, Princeton, New Jersey.

EDMUND W. SINNOTT, Professor of Botany, Barnard College, Columbia University, New York City. (Representative of A. G. A. on Council of Amer. Assoc. for the Advancement of Science.)

W. W. SMITH, Professor of Animal Husbandry, Purdue University, Lafayette, Indiana.

A. B. STOUT, Director of Laboratories, New York Botanical Gardens, New York City.

W. T. SWINGLE, Plant Physiologist in Charge of Breeding Investigations, U. S. Department of Agriculture, Washington, D. C.

W. H. TOMHAVE, American Aberdeen-Angus Breeders' Association, Chicago, Ill.

H. E. WALTER, Professor of Biology, Brown University, Providence, Rhode Island.

H. J. WEBBER, Prof. Subtropical Hort., Citrus Experiment Station, Riverside, California.

E. N. WENTWORTH, Armours' Bureau of Agr'l Research and Economics, Chicago, Illinois.

P. W. WHITING, Zoological Laboratory, University of Pennsylvania, Philadelphia, Pa.

The JOURNAL OF HEREDITY is published monthly by the AMERICAN GENETIC ASSOCIATION at 32nd Street and Elm Avenue, Baltimore, Md., and Victor Building, Washington, D. C. Address all communications regarding editorial matters to Room 308, Victor Building, Washington, D. C. Communications regarding the business management of The JOURNAL OF HEREDITY may be addressed to the publication office, 32nd Street and Elm Avenue, Baltimore, Md., or to the Victor Building, Washington, D. C. Entered as second-class matter February 24, 1923, at the postoffice at Baltimore, Maryland. Acceptance for mailing at the special rate of postage provided for in section 1103, Act of October 3, 1917, authorized December 20, 1918.

Contents copyrighted 1939 by the American Genetic Association. Unauthorized reproduction of material from THE JOURNAL not permitted. The title "Journal of Heredity" is registered as a trade-mark in the U. S. Patent Office.

$3.50 a Year. 35c the Copy. Prices of back numbers on application.

The

Journal of Heredity

Vol. XXX JUNE, 1939 No. 6

CONTENTS

PLATINUM MUTATIONS IN NORWEGIAN SILVER FOXES
By Otto L. Mohr and Per Tuff 227

A MECHANIZED EXHIBIT OF HUMAN HEREDITY
By E. B. Babcock and R. Goldschmidt 235

THE INHERITANCE OF STRONG PARENTAL INSTINCT
By Frederick Adams Woods 237

TEOSINTE AND THE ORIGIN OF MAIZE
By G. W. Beadle 245

NORMAL VARIATIONS IN THE OSSIFICATION OF BONES
By J. W. Pryor 249

SPIKE BLADE—A HERITABLE SINGLE COMB VARIATION IN THE FOWL
By D. C. Warren 257

HERMAPHRODISM IN MILK GOATS
By O. N. Eaton and V. L. Simmons 261

A COLCHICINE-INDUCED TETRAPLOID IN BUCKWHEAT
By W. J. Sando 271

Special Eugenics Section

In Cooperation with the American Eugenics Society

FAMILY PLANNING AND CULTURAL CHANGE
By Lawrence K. Frank 273

GIVING PUBLICITY TO EUGENICS
By Albert Edward Wiggam 279

THE EUGENIC VALUE OF A MATERNAL HEALTH CENTER
By Gladys Gaylord 283

Notes and Reviews

SHIPPING EXHIBIT MATERIAL TO GENETICS CONGRESS 255

DECLINING BIRTH RATE HALTS 260

THE STORY OF BIOMETRY (Rev. of PEARSON: *Karl Pearson*) 267

ZOOLOGY OF THE CHORDATES (Rev. of NEWMAN: *Phylum Chordata*) 269

GENETICS OF MAN (Rev. of GRAF: *Vererbungslehre*) 270

JANE CLAPPERTON—EUGENIC PIONEER 272

HUNTINGTON'S CHOREA IN ILLINOIS 282

THE PROBLEM OF MENTAL DEFECT IN NEW YORK STATE 285

THE WAY TO MARITAL HAPPINESS (Rev. of TERMAN: *Pyschological Factors*) 286

ARE THE TROPICS CLOSED TO THE WHITE RACE? (Rev. of GRENFELL: *White Settlers in the Tropics*) 287

COMING

APOMIXIS IN HAWKWEEDS

Seed production without fertilization, which dismayed Gregor Mendel seventy years ago, is found to tell its own fascinating story of chromosomal evolution.

SEX-LINKED KERATOSIS

Horny overgrowth of the hair follicles causing ingrown body hairs on arms and legs. A new sex-influenced skin defect in man.

EUGENICS AND MEDICINE

A sound eugenics policy seen by a famous physician as being actually a long term public health program.

POLYPLOID AMPHIBIA

Plants have gone extra-chromosome conscious in a big way of late. Now the animals are getting on the band wagon, too, or at least the facts of chromosomal existence are being better understood.

POULTRY GENETICS

A new plumage allelomorph in the turkey, and more about pheasant hybrids.

$3.50 a Year 35c the Copy

Acme Photo

THE PLATINUM FOX BECOMES "NEWS"

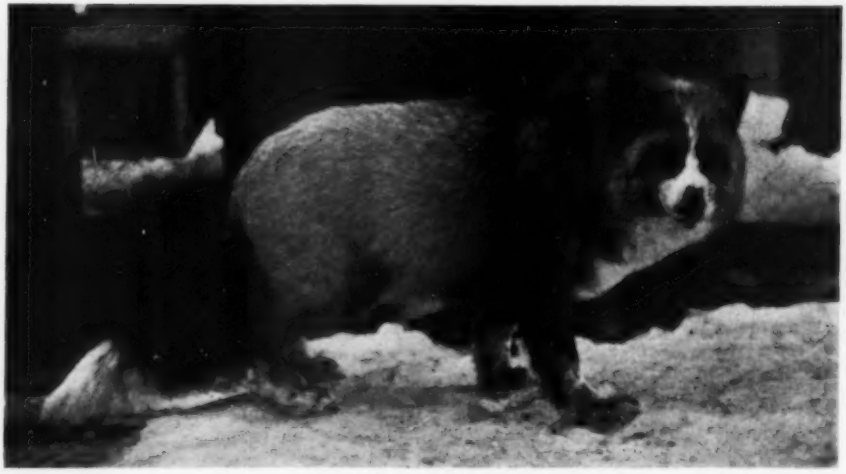
Frontispiece

The dominant platinum mutation in the silver fox got into the fashion headlines when the Duchess of Windsor wore a set of "platinum" furs at the American Legion birthday celebration in Paris, March 17. Platinum pelts are selling, according to the dispatches, from $1,500.00 up, with breeding animals quoted at $7,500.00 per pair. The offspring of mutant "Mons" are undoubtedly the 1939 Economic Royalists of applied genetics.

THE NORWEGIAN PLATINUM FOX

A Coat Color Mutation Having Great Economic Value

OTTO L. MOHR AND PER TUFF
The University and the Veterinary High School, Oslo



THE ORIGINAL PLATINUM MUTANT
Figure 1

"Mons," the first recorded platinum fox. His parents were normal foxes of a Norwegian strain imported from Canada. Breeders failed to recognize the value of the mutation until the platinum furs brought high prices at auction.

ON the silver fox ranch of Martin Evertsen, Dyröyhamn, Troms in Northern Norway, there occurred in 1933, in a litter of six, an exceptional male individual "Mons" (Figure 1), who was lighter than ordinary silver foxes and showed characteristic markings to be described below. His parents and five litter mates were typical silver foxes.

The pedigree of "Mons" is presented in Figure 2 from which it is seen that there has been only a very slight degree of inbreeding in his ancestry. These foxes, as well as Norwegian silver foxes in general, descend from animals which were originally imported from Canada.

The ranch in question was owned by a corporation that was dissolved in the autumn of 1933 and when none of the members of the joint owners wanted to have "Mons," the animal was bought by Mr. Hans Kjaer, Rossfjord in Troms.

Mr. Kjaer, who assumed that this new color type might be due to a mutation, mated "Mons" to an unrelated silver fox female and obtained in 1934 a litter of seven, of which three were ordinary silver foxes while four showed the coloring of their father, though of a somewhat darker type. Kjaer named the new character Platinum. The animals to be dealt with in the following are all descendants from "Mons" and two of his platinum sons.

In 1936 the first platinum furs from Kjaer were sold at an auction in Oslo for very good prices. But when two particularly light platinum furs (Figure 6) at the Nordiske Skinnauksjoner in

Oslo, 1937, brought the price of 4100 Kronor (about $1,000) while the value of ordinary silver pelts was about Kr. 100 (about $25), a regular craze resulted. Male breeding animals have since been sold for prices ranging from Kr. 15,000 to Kr. 25,000, and up to Kr. 5000 has been paid for a single mating.

The Platinum Fur Character

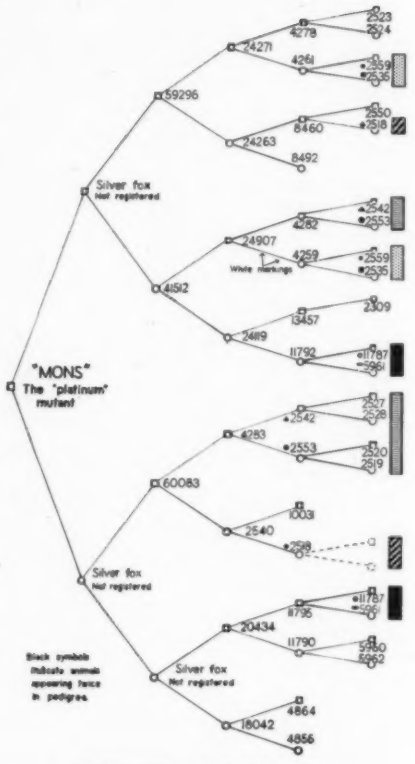
The platinum coloring is considerably lighter than that of ordinary silver foxes, usually a light grayish somewhat like the color of gray horses. The underfur is distinctly lighter than in silver foxes, from near white to a light grayish.

While the only marking in the silver fox is the white tip on the tail, the platinum foxes are characterized by extensive markings: white snout, a white blaze along the nose and forehead joining with a white collar around the neck (Figure 3). The breast and a broad stripe on the belly are white (Figure 3) and the same is true of the legs and the distal part of the tail. The size of the markings is somewhat variable, particularly on the legs, and the white collar may be lacking in dark platinum individuals. In the white markings on the nose and legs there are as a rule small black spots (Figure 4).

The skin is of a grayish shade, somewhat lighter than the skin of silver foxes. In the white markings the skin seems to be unpigmented.

Samples of hairs from the underfur are to a large extent unpigmented, but some wool hairs are found with a discontinuous pigmented medulla, giving the hair the cross-striated appearance, which is typical of the wool hairs from ordinary silver foxes.

Judging from samples of the guard-hairs from the platinum foxes quite a few different color types occur. Some guardhairs are entirely unpigmented, others are pigmented along their entire length except near the tapered end where the pigmentation gradually fades away. Some of these black hairs loose their pigmentation near the root also. Numerous guard-hairs are unpigmented except for a black section near the end,



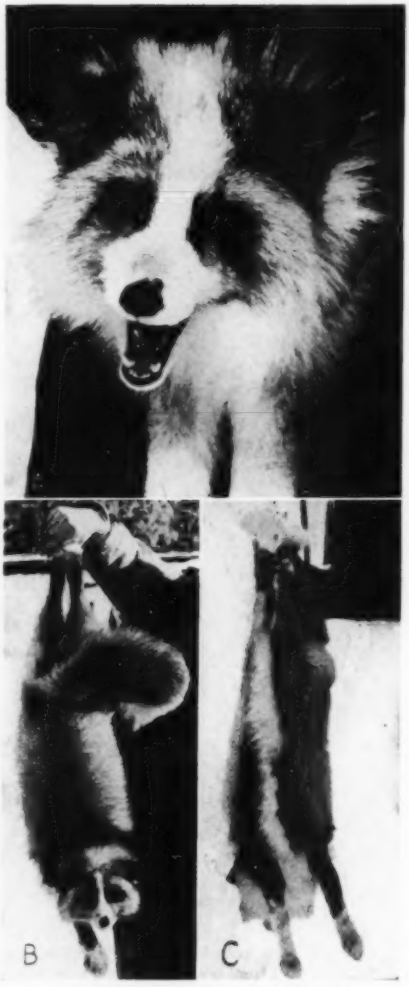
PEDIGREE OF "MONS"

Figure 2

This pedigree of the platinum mutant, Mons, shows that there was a relatively small amount of inbreeding in his ancestry.

the tapered end being again unpigmented. Very common is also the following type: unpigmented tapered and followed by a shorter or longer section of solid black which gradually continues into a poorly pigmented or entirely unpigmented section. Below this section there follows again a relatively long pigmented region which under the microscope appears irregularly cross-striated owing to the pigment being apparently concentrated along the borders of the cuticular scales. Near the root this pigmentation gradually fades away.

The latter type is not unlike the type of guard-hairs which are so characteris-



THE PLATINUM PATTERN

Figure 3

A medium platinum fox, showing the characteristic white snout, white blaze along nose and forehead, white collar, and white legs (*A*), the graded pigmentation on the back and white tip on the tail (*B*), and the white stripe down the stomach (*C*).

tic of the ordinary silver foxes: the solid black tip of the hair (about one cm.) gradually going over into an entirely unpigmented section, the "silver band" (about one cm.). Below this band follows a longer black section (about three cm.) which again looses its pigmentation near the root. While the free end of these guard-hairs is black in silver foxes it seems in the platinum foxes to be a general rule that all types of guard-hairs under the microscope show an unpigmented tapered end.

The above remarks on the color of the guard-hairs of platinum foxes are of a preliminary character. We have not yet had opportunity to study the distribution of types in the different regions or their relative frequency in the darker and the lighter platinum individuals.

Breeding Results

In Table I are presented the breeding results of the matings of platinum fox × silver fox.

To Mr. Kjaer's own data are added those obtained from Mr. and Mrs. Jakhelln, A/S Fox Farm, Osterdalen, who in 1936 bought the original mutant "Mons" and three platinum males from

TABLE I.—Mating of heterozygous platinum fox × silver fox.

Reference	Year	Platinum	Silver
Kjaer	1934	4	3
	1935	34	16
	1936	16	16
	1937	6	13
Jakhelln	1937	36	40
Total		96	88
Expectation		92	92

TABLE II.—Inbreeding of heterozygous platinum foxes.

Reference	Year	Platinum	Silver
Kjaer	1936	1	0
	1937	21	10
Total		22	10

TABLE III.—Grades of lightness in the platinum character among the offspring in matings platinum × silver at the A/S Fox Farm, 1937. Abbreviations: P. platinum; S. silver; L. light; Md. medium; D. dark; E. extra.

Parents		Platinum Offspring				
♂	♀	E.L.	L.	Md.L.	D.	E.D.
E.L.P.	E.L.S.		1			
L.P.	E.L.S.	2	3		2	2
L.P.	L.S.		14	1		
L.P.	Md.L.S.		4			
L.P.	Md.S.		3			
D.P.	E.L.S.		1			
D.P.	L.S.		2			
E.D.P.	E.L.S.		1			
Md.S.	L.P.		1			1
Total		2	30	1	2	3

A DARK PLATINUM TYPE

Figure 4

The expression of the gene for platinum coat varies from this dark pelt to the very light pelts shown in Figure 6. The gene is dominant and autosomal, and has been found to be heterozygous in all animals now used in breeding. Attempts to produce a homozygous type have not yet been successful and the few attempts to do so suggest that the homozygous condition may be lethal, which will slow down the increase of the platinum type.

Mr. Kjaer and mated them to silver foxes.

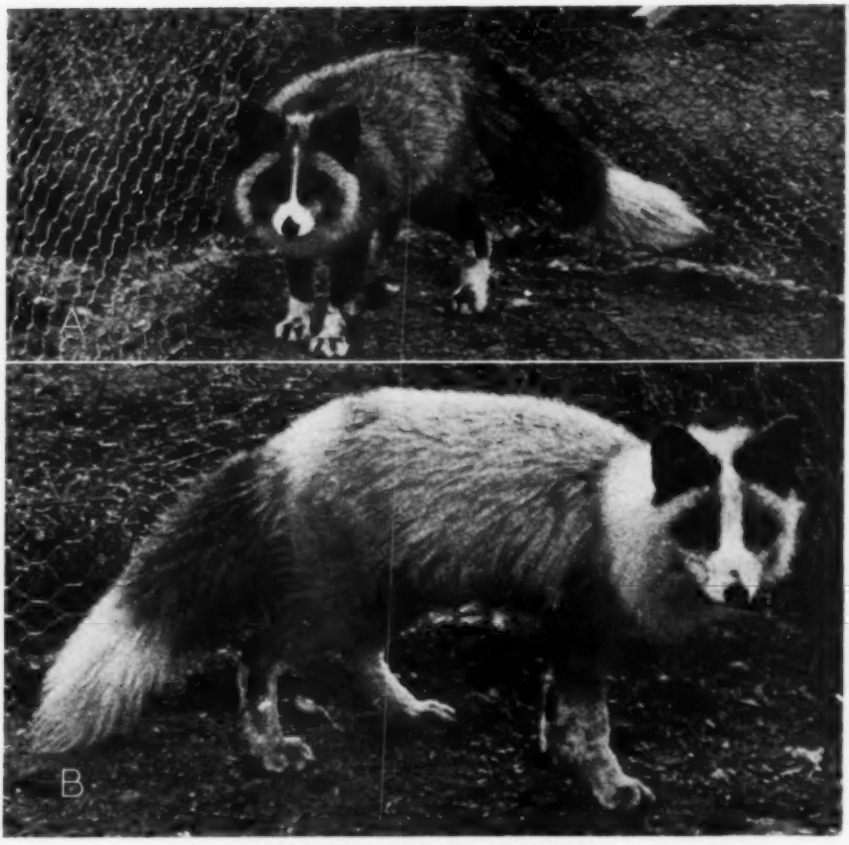
The result clearly indicates that the platinum character is due to an ordinary dominant gene. This mutant gene is not sex-linked, males and females occurring in about equal numbers disregarding the sex of the P_1 platinum individual used.

The homozygous platinum type is as yet unknown. The results of matings platinum $\times$ platinum carried out by Mr. Kjaer is presented in Table II.

The eventual homozygotes could not be distinguished from the heterozygotes among the offspring obtained in these matings. The young vary in degree of lightness, but to no greater degree than the heterozygous platinum individuals.

In estimating the data of Table II it should be emphasized that the litters at Mr. Kjaer's farm are carefully controlled immediately after delivery so there is in this material no possibility of stillborn young having been removed or eaten by their mother. As will be seen the ratio obtained approaches a 2:1 ratio instead of the expected 3:1. This deviation may of course be purely accidental, but the possibility that the dominant platinum gene may be lethal in homozygous condition should be kept in mind.

Both Mr. Kjaer and the Jakhellns agree in the opinion that the platinum cubs are somewhat weaker during the



OTHER "PLATINUM" MUTANTS

Figure 5

Two platinum foxes (summer pelts) from other mutations to the same pattern which have occurred recently in Norway. *A*—Dark type of Hovbrender strain derived from another mutation. *B*—The mutant "Kongen", another platinum mutant in the strain in which "Mons", the original mutant appeared. Breeding experiments are under way to determine whether any of these several platinum types are allelomorphic. (See footnote, p. 333.)

first three months of life than are their silver litter mates. Further data are needed before it is possible to decide whether the reduction in viability among the platinum cubs is real or only accidental.

In order to determine whether homozygous platinum foxes are viable so that a pure breed may be established, platinum foxes derived from the mating platinum × platinum are now tested in matings to silver foxes. In order to be sure that an individual is homozygous, about 20 offspring, all platinum, ought to be derived from the tested individual. The breeders are aware of the gambling chance here involved. While the price for the male platinum young from mating platinum × silver is Kr. 10,000, the price for the male platinum young derived from the mating platinum × platinum is Kr. 15,000.

As mentioned above the platinum character is variable in so far as darker

LIGHT PLATINUM FURS

Figure 6

Two unusually light furs that started the platinum craze in Oslo. These furs, which sold for 40 times the price of standard silvers, revealed the commercial value of the mutation. The very light animals are apparently heterozygous for the dominant platinum gene just as the darker types are.

(Figure 5*A*) or lighter (Figure 5*B*) platinum types occur within the same litter. It has not been possible to decide whether this variability is due to the platinum gene itself or whether, which seems more likely, the variation is due to the genes which are responsible for the variation in darkness in the ordinary silver foxes .

According to an abstract, Iljina[1] finds that the grades of silvering are dependent upon three factors, P_1, P_2 and P_3, but since we have not had access to the original paper we do not know the evidence supporting this conclusion.

Table III shows the grades of lightness among the platinum offspring from matings platinum × platinum. The degree of lightness in the parents is indicated to the left in the table.

Other Platinum-like Mutations

In 1934, one year after the original mutant "Mons" was born, "Mons" silver fox grandmother in a mating to a silver fox male gave birth to a litter of six, one of which, a female, "Bergetta," is said to be typical platinum. Geneticall-ly this new character behaves quite like the original platinum.

The simplest explanation of this new occurrence of the platinum character would be that the mother and the grandmother of "Mons" had been fertilized by the same male and that the platinum mutation had occurred in the germ track of this individual. Careful inquiries seem to exclude this possibility.

The father of "Mons" and the father of "Bergetta" were on the same ranch in 1933 when "Mons" was born. When the matings took place, the males had to be carried into the pens of the females. The male which the following year was the father of "Bergetta" had never been in the pen of "Mons'" mother. The following year the two males were on ranches which are five km. apart. The breeder who has given this information is a reliable man so it seems certain that we are dealing with two independent mutations. Whether the two mutant

genes are identical can of course not yet be told, but they are strikingly similar both in their phenotypic effect and genetically.

"Bergetta," who is owned by Mr. Th. Paulsen, Langhamn, failed to mate in 1935, but in 1936 she gave in a mating to a silver fox male three platinum and three silver cubs, one male and two females being platinum.

In 1937 "Bergetta" was mated to her platinum son "Hugo" and gave three platinum sons and two silver foxes. Hugo was also mated to one of his platinum sisters. The result of this mating was two platinum cubs. Hence, these platinum × platinum matings gave in all five platinum : two silver.

"Hugo" and his other platinum sister were mated in 1937 to silver foxes and in 1938 a series of analogous matings were carried out. The results of these matings of heterozygous platinum × silver is presented in Table IV. From this table we see again that this gene is a typical dominant.

Among the platinum males which in 1938 were mated to silver fox females were also the three males which in 1937 were obtained in the mating of the original platinum mutant "Bergetta" to her platinum son "Hugo." All these males proved to be heterozygous only, giving respectively platinum and silver offspring in the ratios 6:14, 5:4 and 15:19, totaling 26 platinum : 27 silver foxes. These data are included in Table IV.

Mr. Paulsen informs us that according to his experience the platinum cubs are fully on par with their silver fox litter mates as regards viability. He also states that the lightness of the platinum character in the offspring seems to be independent of the degree of lightness found in the platinum parents.

TABLE IV.—Matings of heterozygous platinum fox × silver fox.

Reference	Year	Platinum	Silver
Paulsen	1936	3	3
	1937	6	4
	1938	35	34
Total		44	41

The following additional cases are of particular interest:

On the silver fox ranch of Didrik Hovbrender, Vivestad in Vestfold, South-eastern Norway, there occurred in 1933 a single female "7 K," which is said to be closely similar to the above platinum foxes. This impression is confirmed by the photo of a platinum individual from the Hovbrender strain, presented in Figure 5*A*.*

The female "7 K" occurred in a litter of seven from a mating of ordinary silver foxes. She failed to mate in 1934, but in 1935, when mated to an ordinary silver fox male, gave birth to a litter of six, five of which were platinum. The following year she gave, in a similar mating, three platinum and three silver. In the same year one of her platinum daughters mated to an ordinary male gave two platinum and three silver.

The totals in these matings of heterozygous platinum × silver are ten platinum to seven silver, again indicating a dominant gene for the character.

In 1937 female " 7K" and two of her platinum daughters were mated to a platinum son of one of her platinum daughters. The result of these matings platinum × platinum was eight platinum and four silver, a 2:1 ratio instead of the expected 3:1. As will be noticed, the deviation goes in the same direction as in the platinum × platinum matings carried out by Mr. Kjaer. The numbers are unfortunately so small that these deviations may very well be purely accidental.

Finally the following case should be briefly mentioned.

In 1937 an exceptional male 'Kongen" was born in a mating of ordinary silver foxes in Nordfjord, Western Norway. This individual (Figure 5*B*) which was bought by Mr. P. Svarstad, Lillehammer, is of a very light platinum type, very like the lightest platinum individuals obtained on the Jakhelln ranch

*Since this paper was submitted we have had an opportunity to examine platinum individuals of the Hovbrender strain. It turns out that, while the markings are very similar in the Kjaer and the Hovbrender strains, the fur coloring presents differences which make it clear that we are dealing with two distinct mutant types.

(Figure 6). This male has not yet given offspring so his genotype is unknown.

We have also been informed that a platinum mutation has occurred in Hallingdal, Central Norway, but details are as yet lacking.

If it should turn out that all these platinum mutations of different origin are genetically identical or allelomorphic, we are accordingly confronted with a gene which shows a fairly high degree of mutability. Kjaer has the impression that it is a particular line of the imported foxes, the Beetz—or Quebec—foxes which shows this tendency to platinum mutations. We have not yet been able to investigate this special point.

Unless it should turn out that the platinum gene is lethal when homozygous, it will be a very difficult task to decide whether we are dealing with mutations of a single locus or with different mutations phenotypically analygous.

"Platinum" Mutations in Other Countries

So-called platinum silver foxes have also been bred in the United States, Finland and Sweden, but these seem to be different from the one here dealt with.

According to a paper by Harry J. la Due in the *American Fur Breeder* quoted in *Våra Pälsdjur*,[2] the American platinum fox is a bluish or lavender-like color type without markings. This character also seems to be due to a dominant gene and a constant breed is established at the Kelmoor Fox and Fur Farm.

A Swedish breeder who has imported individuals of this type states in a letter that the Kelmoor type is strikingly different from the Norwegian platinum foxes and much more like the color of ordinary blue foxes.

The same article described color varieties also found in blue foxes and in mink. It is also said that a hereditary variety with white head markings has occurred in the silver fox in 1931 and that this type is bred at Colpitts Bros., in New Brunswick. According to information received from Chief Inspector Rochmann, these head markings are not unlike the ones found in the Norwegian platinum foxes, but in other respects these foxes are said to be different from those here described.

Not infrequently different markings or color varieties are encountered in the silver foxes, but exceptional individuals have as a rule been excluded from breeding since their character did not correspond to the orthodox standard. With the psychology of fashion in mind breeders should be advised to keep and test such aberrant individuals. Some of them may very well represent hereditary varieties of distinct commercial value.

In concluding we wish to acknowledge our indebtedness to Mr. Kjaer, Mr. and Mrs. Jakhelln, Mr. Paulsen, Mr. Hovbrender and Mr. Svarstad for the liberality with which they have placed their data at our disposal.

Summary

A character of considerable commercial value arose by mutation in 1933 in a strain of ordinary silver foxes in Northern Norway. The character is denoted as platinum.

The fur of platinum individuals is of a light grayish shade with extensive white markings on snout and forehead, neck, belly, legs and the distal part of the tail.

The character is inherited as a clear-cut autosomal dominant. The homozygous type is as yet unknown. Inbreeding of heterozygous platinum individuals has so far given platinum and silver foxes in the ratio 2:1, but the numbers are so small that this deviation from expectation may well be accidental.

Analogous mutations have occurred independently on three (possibly four) additional occasions.

Phenotypically these other mutant types are very similar to the one first described, but whether these different platinum mutations are identical or unilocal can not yet be told.

Literature Cited

1. Iljina, E. D. Principles of genetics and breeding of fur-bearing animals. Moskva 1935. Abstract in *Animal Breeding Abstracts*, vol. 4: 393-94. 1936.

2. La Due, H. J. Värdefulla mutationer. *Våra pälsdjur*, vol. 8:385-92. 1937.

A MECHANIZED EXHIBIT OF HUMAN HEREDITY

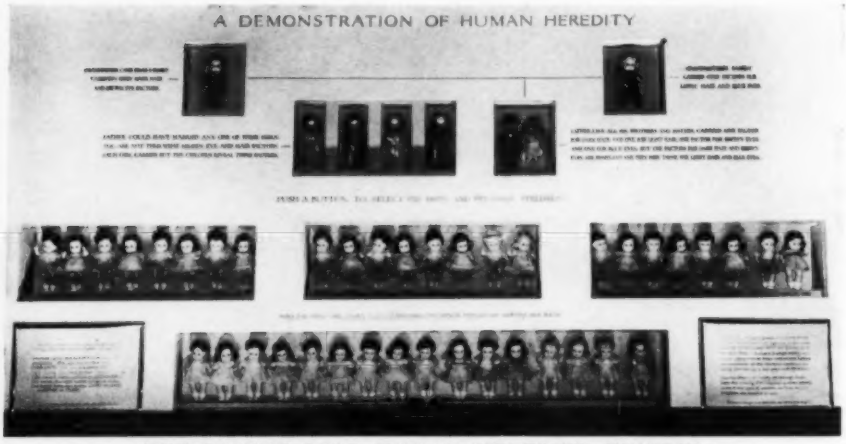
Golden Gate Exposition Demonstration of Mendelism

E. B. Babcock and R. Goldschmidt
University of California, Berkeley

FROM the point of view of interest to the general public, the mechanized exhibit of human heredity in the biology section of the University of California exhibits in the Hall of Science of the Golden Gate International Exposition has proved a great success. Of course, the oral reactions range all the way from, "Oh! How pretty!" to "Aha! Mendel's law, eh?" Although it is very probable that the great majority of the hundreds of thousands of persons viewing this exhibit fail to learn very much about the laws of heredity, yet the mere recognition of the fact of human heredity on the part of so many may be a worthwhile achievement. At the same time some of the many spectators do actually learn something of value from this exhibit and they appear to appreciate the effort of the University in opening up the subject to them.

The exhibit consists of a wall panel 14 feet long and 10 feet high in which are used 95 boy and girl Dionne dolls, made especially for this purpose. The two pairs of characters demonstrated are dark *vs.* light hair and brown *vs.* blue eyes. Three generations are shown, grandparents, parents, and children. One doll of each sex, appropriately dressed, is placed near the top of the panel as the grandfather, who comes from a family with only dark hair and brown eyes, and the grandmother, who has light hair and blue eyes. Below these appears their son, who has dark hair and brown eyes but is heterozygous for both (i.e., he carries a hidden factor for light hair and another for blue eyes) and on his right are shown four girls, each with a different combination of the two pairs of characters. Each of these possible brides wears a differently colored dress and on the rail below are four buttons with colors corresponding to the dresses of the four potential mothers. The spectator "chooses the bride" by pressing the appropriate button; the four girls disappear, and the chosen one reappears in another alcove dressed as a bride along with the future husband. A few minutes later covers are lifted from one or more alcoves on the lower part of the panel, disclosing the theoretical proportions of hair and eye-color combinations among the children, together with equal proportions of boys and girls.

The number of "families" necessary to demonstrate all the possibilities depends, of course, upon the characteristics of the girl chosen as the future mother. If the girl with light hair and blue eyes is chosen, only one theoretical distribution is possible, because she is necessarily homozygous, (i.e., she carries only the factors for light hair and for blue eyes). In this alcove are shown eight children, a boy and a girl with dark hair and brown eyes, a boy and a girl with dark hair and blue eyes, another pair with light hair and brown eyes, and another with light hair and blue eyes. The possibilities for the other three marriages are more numerous. The girl with light hair and brown eyes may be either homozygous for brown eyes or she may carry a hidden factor for blue eyes; so two different families are presented to show the possibilities in each case. The girl with dark hair and blue eyes may be homozygous for dark hair or she may carry a hidden factor for light hair; so again two different groups of children are shown. Finally for the girl with dark hair and brown eyes there are four possibilities: she may carry no hidden factors, she may carry a hidden factor for light hair, or one for blue eyes, or hidden factors for both. Accordingly in this case four possible families are illustrated. In the case of each family the hereditary



THE DIONNE DOLL HUMAN HEREDITY EXHIBIT

Figure 7

Photograph of the demonstration of human heredity at the San Francisco World's Fair. The exhibit is shown with all panels open, a condition never seen by the ordinary spectator. As a rule, when the four possible brides are visible the bride and groom are not visible, and the possible families of children are shown only after selection of the bride by the spectator. The four different families of children, shown above, all appear when the spectator selects as bride the girl with dark hair and brown eyes.

factors present in the mother are stated in a legend immediately below the children.

Neatly printed at the sides of the large panel are the following explanatory legends.

On Left Side of Panel

Dominant dark hair (*D*) hides recessive light hair (*d*).

Dominant brown eyes (*B*) hides recessive blue eyes (*b*).

Grandfather (*DDBB*) dark hair and brown eyes. Grandmother (*ddbb*) light hair and blue eyes.

Father (*Dd Bb*) dark hair and brown eyes.

Light haired, blue-eyed mother *ddbb*.

Light-haired, brown-eyed mother *ddBB* or *ddBb*.

Dark-haired, blue-eyed mother *DDbb* or *Ddbb*.

Dark-haired, brown-eyed mother *DDBB* or *DdBB* or *DDBb* or *DdBb*.

Any parent contributes one eye-color factor and one hair-color factor to each son or daughter. Thus, father *DdBb* will furnish *DB* or *Db* or *dB* or *db*, whereas the light-haired, blue-eyed mother *ddbb* will furnish only *db*, giving four types of children in equal proportions.

On Right Side of Panel

Note that the family groups of children exhibit the ideal mathematical proportions of the various character combinations which are determined by Mendel's laws. Actually a single family will seldom contain these exact proportions because the distributions of the character combinations among the offspring is also subject to the laws of chance. From the viewpoint of heredity, the marriage of the father was a mating of an individual of known ancestry to any of four types of unknown ancestry, to determine the heredity of each.

The Mechanism

The smoothly working mechanism consists of a large drum, divided into alcoves containing the "families," and operated by an electric motor with an automatic stopping device, so connected with the four buttons as to always stop at the proper place. The disappearance of the four possible brides and reappear- of the bride and groom are provided by a disappearing panel, like those covering the families-to-be, together with a smaller drum with four alcoves each containing a different bride and groom, and similarly controlled to stop according to the button pushed. For the ingenuity and care used in working out the many details connected with this exhibit, the committee on heredity take pleasure in acknowledging the highly valuable assistance of Dr. Jay F. W. Pearson.

THE INHERITANCE OF STRONG PARENTAL INSTINCT

As Proved in the Records of Royalty

FREDERICK ADAMS WOODS

THE renunciation of the throne of empire by King Edward VIII has made more than usually significant the discussion of the many biological relations of such actions, especially in regard to the maintenance of the royal families considered as a separate breed. In a former article (JOUR. HERED., Nov., 1936) I showed that only those whose tendencies are to choose their mates among their own highly pedigreed castes become the parents of a sufficient number of children to perpetuate their kind. This was entitled "Thoroughbreds Have More Children." The present article is to show the general high fecundity of royal families, to inquire into the causes and also to demonstrate to a considerable degree, an inherited strong parental instinct. Also it is to disprove the false assertions that luxury leads to sterility and that aristocratic families tend to disappear. This is the old cry from unscientific historians, of which there are many. The downfall of Greece, Rome and other highly civilized communities has been attributed to it, but little scientific proof can be found to support this assumption.

In this JOURNAL for September, 1928, I showed that 334 of 622 British peers of today descend from families already aristocratic by the middle of the fifteenth century, and that a great many of the founders became ancestors of two or more males who in their turn were raised to the peerage, so that there are now many nobles of the same family name once held by a single ancestor. The present group is much more socially exalted and of greater wealth and power. The material therefore is more convincing and here we meet evidence which can alone be explained by the inheritance of mental and moral traits.

In completing the data, use has been made of the entire genealogical section of the *Almanach de Gotha* for 1923. This is divided into three parts. The first division concerns the sovereign houses, also the former sovereign houses deposed in the nineteenth and twentieth centuries. There are 21 families and about 900 individuals. Details concerning the other two divisions will be given later. In the former article, the 1933 and 1935 editions were added in supplement. Here use has been made only of the 1923 edition, because it happened to be the copy on which I had made marginal notes for several years. That it is not the most recent makes no difference since the generalizations and panoramas now presented are part of the long sweep of human evolution, growth of civilizations and institutions, such as noble and royal castes, family life, mental and moral inheritance, differential fecundity, and chiefly the parental instinct—something that among vertebrates started in the amniota (birds especially) millions of years ago. All these in the course of ages doubtless have had their important changes, but not between 1923 and 1937.

Bourbon-Orleans House

Let us begin with the House Capet generally known and represented today by one of its branches, the Bourbons. Of all families that have ever lived probably none has equaled them in extent of power and historic importance. All descend in the various male-lines from Robert the Strong, Duke of France, Count of Paris, of Orleans and of Anjou who died A. D. 886 fighting against the Northmen. If it be a natural desire to wish to leave many male descendants to carry on the name and make it eminent, then Robert the Strong, is in this

respect the Number One ancestor of all time. Two of his sons became Kings of France, Eudes (888-898) and Robert I (922-923). His descendants (with the exception of the two Napoleons) held the throne of France until the close of the Nineteenth century. It so happened that a younger son went to Portugal and founded there the family that under the leadership of Prince Henry the Navigator contributed so much to modern knowledge of geography by the circumnavigation of Africa and the discovery of the sea-route to India.

Burgundy, until the death of Charles the Bold in 1477, was a nation comparable in strength and magnitude with the France of that time. Louis XI beat Charles the Bold but when the wiley Louis took away French Burgundy from the rightful heirs he was taking property that belonged in the family, though their relationship was remote. Both Louis and Charles were male-line descendants of Hugh Capet.

The other branches of this French Capet family include six descendants of Don Carlos, the so-called pretender to the throne of Spain in the early XIX Century. It is curious irony of fate that Don Carlos, who happened to be the head of the primogeniture line of the oldest of the most powerful of families, should be known as a "pretender" but this is one of those many oily words that are inevitable to party politics. The branch of the Two Sicilies adds 23 and a so-called third branch adds eight more. Then we have the branch of the Dukes of Parma which brings 27, France at present represented by the Royalists, Bourbon-Orleans, tallies thirty-five, and the recently expelled Spanish house includes 33. Braganza adds 19 more. This brings the total to 151 and makes the second oldest of the royal families the most numerous of all.

With the exception of the Spanish Carlists all appear very fecund at the present time and their average for recent marriages is 3.7 living, and, usually, already adult offspring. Large families are frequent. There is one of six and one of ten children. There is one of eight and one of seventeen. These last two can not be counted as biologically equivalent to the others, since while there were only two fathers there were four mothers. However, it is all the same for maintaining the House Capet which in spite of its political misfortunes appears to be as determined as ever to marry its more or less close relatives and to go on breeding children.

From now on the principal families will be taken up in the order of their antiquity of origin, or in other words, how "old" they are. In one sense all families are "old," but here the word is used to signify how far back in the line of the father's father's father, etc., the pedigree can be traced with documented certainty. Documented certainty means very high social position for any family in any country during the middle ages.

The oldest European family of sovereign rank appears to be Hesse (Maison Brabant) which traces to a marriage about the year 846 between Count Gisilbert in the land of Meuse and a daughter of the Emperor Lothaire I, — consequently a great-granddaughter of Charlemange. There are four branches at present and 37 members, not counting wives. The Battenburgs (Mountbatten) add nine, including the ex-queen of Spain; but on account of a morganatic marriage these latter do not rank quite so high and have been relegated to the third division of the *Almanach*. Such demotions are fairly frequent and are one of the contributing causes to the conservation of royal breeds as a biologically pure and as an inherently aristocratic species. This was dwelt upon in my preceding article. While there are no very large fraternities (7 or more) among the branches of the House of Hesse the net fecundity is high, being 3.4.

The Hapsburgs

The third oldest dynasty is that of Hapsburg-Lorraine. As the real Hapsburgs ceased with Queen Maria Theresa of Austria in 1780, our statistical study is concerned with Lorraine which is the family of Francis I, the husband of the famous queen. It may be remarked, how-

ever, that the Hapsburgs themselves were of very ancient origin (A. D. 952) taking their source in Gontran-les Riche, Count of Altenbourg, a strong chateau, now in ruins in the Canton of Argovie, Switzerland. The paternal ancestry of the late Emperor Franz Joseph and of Otto, the young heir to the throne of Austria and of Hungary, is traced to Richwin count of Verdun (A. D. 883) of whom the sons Othon and Godfroi were dukes of Lorraine. The total today numbers 75. There is the branch called Tuscany and many are descended from various uncles and brothers of former emperors, the number of children averaging 4.9. Austria proper has 31 from eight marriages — an average of nearly four, and Hapsburg-Tuscany 28 from four, an average of just seven. This is an astonishing average.

The next in order is the Bavarian family of Wittelsbach. They take their aristocratic origin in a military leader who died in 907. After that they became dukes of Bavaria (907-938) and counts palatine of the Rhine and electors of the Empire. They gradually grew in power and became kings in the 19th century. They now number 45. Eight marriages produced 23 offspring,—a low average for royalty, 2.9.

The House Wettin (Saxe, Saxony, Belgium, Bulgaria, etc.)

One of the most famous, successful and prolific of historic families is the House Wettin. It begins authentically in the person of Thiadmar, Count Dedo, A. D. 919. From him descend from fathers to sons nine royal families of the present day. They are as follows: Great Britain, Saxe-Weimar, Saxe-Meiningen, Saxe Altenburg, Saxe-Coburg and Gotha, Saxony, Bulgaria, Portugal and Belgium. When one thinks of the enormous social prestige of the royal family of the British Empire with its 450,000,000 subjects, to say nothing of the several minor branches as in Belgium and Bulgaria, and compares it all to the modest position of Count Dedo of the year 919, one realizes that aristocratic families may grow as well as decline. They total 97 individuals and show no evidence of dying out. On the contrary they appear to be increasing, since 27 marriages have resulted in 87 offspring, netting a mean of 3.2.

Sixth in order of antiquity comes Guelph. This celebrated family takes its origin in Othbert I, Margrave and Count Palatine of Este in the province of Padua, Italy, A. D. 960. The name Guelf comes a little later and also the title of Duke of Bavaria, — both by marriage. The great jump, however, was not made until, by strange chance, the Elector of Hanover came upon the throne of Great Britain and Ireland as George I, March 22, 1701, and the Stuarts were expelled. Queen Victoria was the last sovereign of this line in England, but a branch exists in the princes and princesses of Brunswick-Lunebourg and numberd in 1923 ten members. The one recent marriage produced three boys and a girl. It is a case of threatened extinction because in the past there were too many girls.

The House of Savoy in Italy, like that of Saxony — now so widespread — has grown rather steadily in political importance and hereditary rank. The first to leave any impression in history was Umbert I, Count of Savoy, in 1032. They became dukes in 1238 and princes in 1313. The head of the family was king of Cyprus in 1485, king of Sicily in 1713, king of Sardinia in 1720, king of Italy in 1861, with the Papal States incorporated in 1870. There are 18 members of this family, which shows no sign of extinction, — average 2.6.

The royal house of Anhalt which is interesting chiefly as giving origin to Catherine the Great of Russia began some time prior to 1059 in the person of Count Esicon, who died in that year. Never a very important family compared with the others here listed, it now counts nine members.

Next in order of age is the family of the Grand-Duchess of Luxemburg and the Queen of Holland. These are branches of the House of Nassau made famous by William the Silent, Maurice of Nassau, and William III of England. This line is now extinct as regards males.

Nassau is the only one of the twenty-four sovereign families thus situated. Grand Duke William who died in 1812 had the bad luck, from the standpoint of the perpetuation of a name, of having six daughters and no sons. Furthermore his father's brother, who was fully pedigreed (his mother being a princess of Wurtemberg), married in London, morganatically, a divorcee. Their children have stepped down a little and are now in the hand book for German nobility with the rank of count, i. e. *Tachenbuch der Graflichen Häuser.*

Holland is also unfortunate in the hazard of male production, the present queen being the last of that branch of the House of Nassau. There are no brothers or sisters or nephews, no representative of this branch except the daughter. The entire family nevertheless numbers eleven members lineally descended in male lines from Ruthbert, Count of Zutphen, a title traceable as early as A. D. 1059.

Next in age, rank the Hohenzollerns, who can document their pedigree to feudal nobility (von Zollern) who appears out of the mists about the year 1060. By 1208 Conrad, Count of Zollern was Burgrave of Nuremberg. From him descend the ex-Kaiser and the 39 other members of this stem. The older branch descends from Frederick, also Count of Zollern and Burgrave of Nuremberg in 1205. The royal family of Roumania is of this branch of the Hohenzollerns which adds 20, thus giving a total of 60 for the entire group. This average for living offspring is 3.6.

Mecklenburg dates from a little earlier than 1060. They were princes from 1170 and dukes from 1348. The family now totals 18. Their alliances have usually been with similar German royal families. They never produced famous personages and apparently never carried any degenerate or insane strains. Therefore their biological influence, though not genius producing, must have been sound. The queen of George III of England was of this family.

Oldenbourg — Holstein — Denmark — Russia — Norway — Greece

Few characters in history have been more remarkable in becoming an ancestor of kings than Egimar, an obscure Count of Aldenburg, who gained his title in 1088. From him descend the royal houses of Oldenburg-Holstein, Denmark, Russia, Norway, and Greece. Two nobles living in the eleventh century are now represented by 118 royalties. This is the second largest family in this list.

There are seven male lines remaining. As these are comparatively unimportant they may well be grouped together and passed over rapidly. They are as follows: Baden, tenth century, six persons; Liechtenstein, 1143, 45 persons; Lippe, 1123, 82 persons; Reuss, 1122, 51 persons; Schwarzbourg, before 1000, eight persons; Waldeck, before 1100; 19 persons; Wurtemberg, 1081, 20 persons. Total 231. In other words fourteen noble individuals living before 1150 have increased to 231. Their offspring averages have not been computed, as there is enough data without them.

Having reviewed 19 of the 21 families of the first grade of royalty, we now pass over many centuries before reaching the final two, Sweden and Bonaparte. The fact is worth pondering on that six and a half centuries passed and yet no new and now existing royalties appeared. Of these 19 historic houses the most parvenue dates from A. D. 1143.

Sweden (1806) is now ruled by the House of Bernadotte, being descended from that Bernadotte who was one of Napoleon's marshals and adopted as a son and heir by Charles XIII. He was the son of a French lawyer with plain ancestry but he married a pure blooded royalty and the succeeding unions were also with fully pedigreed princesses, so that today there is not much non-royal blood left. There are 17 members in the family.

Victor Bonaparte, born 1862, is not the head of the elder branch, but he and his brother and sister and children are the only ones in the first division of the

Almanach de Gotha. He descends from Jerome, King of Westphalia. This branch counts five members.

It will now pay to analyze and summarize this series of 21 male lines, perhaps on the whole the most powerful, when viewed historically, of any inter-allied families known to history. It is a curious fact that the most famous are almost without exception also the most ancient. The only exception is that Hesse, the very oldest (A. D. 846) is not especially famous, and of course Napoleon is here as elsewhere the constant surpriser. It is but another piece of evidence of the extraordinary achievements of the Corsican advocate's son, whose mother was a peasant, that Europe waited 756 years—from 1143 to 1806—for any man to found a "sovereign" male line that would endure in 1937, and the "Corporal" founded two of them, for certainly the Bernadottes would not have become royal if it had not been for him.

Reasons for Royal Fecundity

These sovereign families, whether reigning or deposed, are having numerous children. Many of them show large fraternities of seven or more living offspring. The averages are always high—none under two and a half—and only two (Italy and Bavaria) that fail to exhibit well over three. This is shown in Table I where it can be seen at a glance how very numerous are most of these ancient tribes. Only four of the twenty-one exhibit less than ten individuals and these have been and are relatively unimportant houses. Bourbon (Capet) and Oldenburg (which means also Denmark, Holstein, Russia, Norway, and Greece) each tally populations of over one hundred. Wettin (Great Britain, etc.), 97, and Hapsburg, 75. One might expect more examples life Guelf, once very famous and now small in number—being ten—but there are no others. It must have some hidden significance; continuous historical importance is correlated with present day size.

Let us now consider the reasons for the very large fraternities that are so frequent. Among the 21 families with their total population of 903 there are 17 cases of from seven to twelve full brothers and sisters. If these were distributed at random there should be one case for every 52.1 persons. On the contrary Hapsburg and Capet exhibit nine instances with a total population of only

TABLE I.—Size, fecundity and antiquity of 21 Royal Families. With the exception of Bourbon (Capet) all are arranged in the order of their antiquity.

	Number of Persons	Average No. of Offspring	Date of Origin
Bourbon, etc. (Capet)	151	3.7	886
Hesse	37	3.4	846
Hapsburg (Austria, etc.)	75	4.9	883
Wittlesbach (Bavaria)	45	2.9	907
Wettin (Great Britain, Saxe, etc.)	97	3.2	919
Guelf (Brunswick)	10	4.	960
Savoy (Italy)	19	2.6	1032
Anhalt	9		1059
Nassau	11	3.5	
Hohenzollern	60	3.6	1060
Mecklenburg	18		1060
Oldenbourg (Denmark, Russia, etc.)	118	3.9	1088
Baden	6	—	10th Century
Liechtenstein	45	—	1143
Lippe	82	—	1123
Reuss	51	—	1122
Schwarzbourg	8	—	before 1000
Waldeck	19	—	before 1100
Wurtemberg	20		1081
Bernadotte (Sweden)	17	3.7	1806
Bonaparte	5	—	1806
Total	903		

226. These nine marriages totalled 76 children — an average of over eight!

The very large families are over and over again (on one or both sides of the house) some branch of either Hapsburg-Austria or Bourbon (Capet) especially Bourbon-Parma or Bourbon—The Two Sicilies. For instance we have, page 7 of the *Almanach*, Austria marrying Bourbon-Parma = 8 children; page 11, Austria × Bourbon-Parma = 7 children; page 12, Austria × Bourbon = 10 children; page 13, Austria × Austria = 8 children; page 16, Bavaria × Bourbon = 9 children; page 23, Bourbon-Two Sicilies × Bourbon-Two Sicilies = 10 children; page 27, Bourbon Parma × Portugal (Capet) = 12 children; page 31, Portugal (Capet) × Löwenstein = 7 children; page 32, Portugal (Capet) × Löwenstein = 7 children; page 64, Liechtenstein × Austria = 8 children; page 67, Saxe-Coburg-Gotha × Austria = 7 children. The "large family" idea seems also to run among the Liechtensteins who figure again: page 64, Liechtenstein × Leichtenstein = 8 children. These thirteen instances leave only four for all the rest of royalty. Thus a population of 271 gives over three times as many very large fraternities (with rather close intermarriage) than the remaining 632. And there is more to it than this: the remaining four instances are none of them very extraordinary,—none more than seven. They seem like random or scattering examples in a population of 632. They are: page 36, Denmark × Sweden; page 87, Prussia × Sleswick Holstein; page 90, Russia × Russia; page 110, Schaumberg × Ahnalt.

This intense concentration of very large fraternities towards Hapsburg and Bourbon suggests very strongly that it is an hereditary tendency. This will be discussed later.

In the second division of the *Almanach*, — a lesser grade of royalty, these extremely large fraternities are also numerous, there being 29 examples in a total population of 1,677. Here they are not quite as plentiful as in the first division, — being one case to every 57.8 of the whole, instead of one case to 52.6.

In the third division, a group even more removed from royalty of the first rank (being various European dukes and princes) the number of cases of more than six children falls to only 37 in a total of about 3,200, or one case to 86.5 persons. This steady decline as we go out from the most exclusive towards the castes that are less so is very impressive. We are evidently here dealing with some generalized principle. It may be that royalty of the first grade has more of these large families than the other two because they are on the whole a richer group, but this seems unlikely. It also will be discussed later.

Then comes the question of religion. Since these very large fraternities concentrate around Austria, Spain and the Bourbons, — all Catholic, it is natural to think that religion may have something to do with it, but there is one very strong argument against it, and that is the general and surprising fact that Catholic royalty does not have any more children than Protestant. The grand average for all the 21 families here listed is 3.62 offspring. Some of these like Hohenzollern and Nassau are partly Protestant and therefore difficult to analyze, but if we select the six principal strictly Catholic ones, namely Capet (Bourbon), Austria, Bavaria, Italy, Portugal and Belgium, we find that 76 marriages produced 264 children or an average of 3.47, which is slightly *lower* than 3.62, the grand average. Also Italy, Belgium, Catholic Nassau, Catholic Hohenzollern, and the House of Bonaparte show no instances of such numerous sibs. They are uncommon in Catholic France and rare among the Catholic princes of Italy. Therefore religious denomination has no causal relationship with either the very large fraternities or the general high fecundity of royalty. This does not mean that the religious temperament so often allied with domestic virtues does not enter perhaps largely as an important factor, and such may well be to a considerable extent hereditary.

The Desire for Male Heirs

Another reason often given why the royal families are so large is that the

need for male heirs to secure the succession is here of primary importance. Thus Popenoe and Johnson in the 1933 edition of *Applied Eugenics* (p. 113) state that royal families are usually large because of the desire for heirs and other advantages to be gained. Just what is meant by "other advantages" is rather cryptic. At least among royalty of the lesser grade, younger branches, et cetera, it is difficult to see how a large family, especially if there are many daughters, is any advantage, since dots must be provided for each. The natural desire for male heirs to secure the succession appears obvious and I had always supposed this to be an important factor, but curiously enough there is no statistical evidence for it. For instance, in the family of Löwenstein, page 193, there were four daughters followed by a son and followed by a daughter, and then followed by another son. Such an order of sex-birth as this might well suggest a fulfilled desire to have two sons.

Better still is the example in the family of Lobkowicz, page 189, where six daughters are finally followed by two sons. Another excellent illustration of what we might expect, were the desire for masculine offspring a reason for large fraternities, is the case in the family Löwenstein-Wertheim, page 191, where six daughters are followed by one son, and then no more children.

In order to decide this question satisfactorily, once and for all, I have made a list of all cases in the first and second divisions of the *Almanach de Gotha* for 1923 which include seven or more children, and then analysed the order of the births of males and females. If this desire for a male offspring were exceedingly strong there would be many cases of daughters in the early years of marriage and then sons towards the latter years. To make this clear let us assume an extreme case. Suppose that as soon as one son appeared the parents absolutely never had any more children. Then the distribution might be like this: Here are represented ten fraternities, *A* to *J*, the children of ten different parents. The first, *A*, has three girls (*F*) followed by one boy (*M*). The second, *B*, one girl followed by a boy, the third, *C*, one girl followed by a boy, and so on:

A—FFFM; *B*—FM; *C*—FM; *D*—FFFFFFM; *E*—FM; *F*—FFM; *G*—FM; *H*—FFM; *I*—FM; *J*—FM.

These results are not imaginary but are from the actual throwing of a coin, one side considered as female and one as male (ignoring all one-male families). Since according to the rules of the game just as soon as the "male" side turns up a new "family" is started there never can be any cases of daughters following sons. Now suppose this tendency (or wish) is present though not in such an immoderate degree, then the same sort of distribution will make itself felt though to a lesser extent. But as a matter of fact the cases like the three already cited which furnish evidence in favor of such a theory are not any more numerous than those opposed.

In a footnote* are listed the seventeen cases of fraternities of seven or more among the first division of royalty. The sequences in the sex distribution are shown by the initials *M* (male) and *F* (female). We have first (p. 7) from the Hapsburgs of Austria, a family of eight beginning with a son and ending with a daughter. Let us inspect each case to see if there is any perceptible tendency showing a desire for male heirs. The first one is certainly against any such

*Distribution of sexes in Royal Fraternities of more than seven children. *M*=male; *F*=female. *P* (Pro)=in favor of theory that desire for a male heir dictates size of fraternity; *C* (Con) against theory.

P. 7 Austria MFMMMMFF *C*; p. 9 Austria FFFFFFM *P*; p. 11 Austria MMMFFFF *C*; p. 12 Austria FFFMMFMFMM *P*; p. 13 Austria FMFMFFMF *P*; p. 15 Bavaria MFFMMFFFF *C*; p. 23 Bourbon MMFFFMMMM *P*; p. 27 Bourbon 2d marriage FMMMFMMFFFFM, (by 1st mar. FMFFM) *C*; p. 31 Bourbon Capet Bragance 1st mar. MF, 2nd mar. FFFFFMF *P*; p. 23 Capet Bragance FMFFFFF *P*; p. 36 Denmark MMMFFMF *C*; p. 64 Liechtenstein FMMFMMMM *C*; p. 64 Liechtenstein MFMMMFMM *C*; p. 87 Prussia MMMMMMF *C*; p. 100 Russia FMMMMMM *C*; p. 107 Saxe-Coburg FFMMFFM *P*; p. 111 Schaumbourg FMMMFFF *C*. Total: 17 cases, 10 are against the theory that large families are due to a desire for male heirs. Only seven are in favor of it.

theory. The eldest is a son. This is followed by a daughter, then another son and then another. Thus by the fourth child there were already three sons and one daughter. By the fifth there was another son. Surely there was then no need to continue offspring in order to secure male succession. Again another son was born and he was followed by two more who were girls. Such cases as this are obviously against a theory that the large families are in part due to desire for males. They are here marked with a *C*, meaning "against." Those favoring this theory are marked *P*. The second case (page 9, Austria) is an excellent example of a distribution of sibs *favoring* such a theory. Nothing could be more so. Six girls in succession are finally followed by a son, and then no more. If this record were taken by itself one would feel convinced that the parents only meant to continue having children until a son should be born. The third (p. 11) however is against the theory. Of the seventeen cases there are ten decidedly against the idea that large royal families are due to a desire for male heirs. There are only seven in its favor.

As this total is not large enough so far to decide the issue the second division of the *Almanach* has been added.* These total 29 cases of seven or more living children, usually mature, the highest number being eleven. Of these we find 11 cases against the theory and 18 for it. Adding these to the data from the first division we now have 28 for and 28 against,—a perfect balance. Again the total remains small, but it does show that there is not much in the idea as there is no tendency shown in 56 trials.

To make a total of sufficient magnitude the sovereign families of five and six have been added. When the first four births were preponderently males the examples are counted as "against," when two were males, as neutral; and when the first four were deficient in males as being in favor of the theory. This adds 42 more: 13 are for the theory and 16 against; 13 are neutral. So now out of 85 tests 44 are against the theory that the large families are caused in part by desire for heirs and 41 are for it.

Furthermore the total number of boys among the first four born in these fraternities of five to twelve is not less than that of the girls. If the first four showed an excess of girls it would argue that more children were desired and that larger families resulted in order that heirs might be achieved. Indeed the ratio happens to be just the same, 172 male to 172 female. These numbers are large enough to be convincing.

Another argument is the following. Surely the desire for male heirs should have been greater among the sovereign houses of the first division of the *Almanach* than among the German mediatized families of the second division, who though considered as having rights of equality of birth with the sovereign houses have not been reigning since the days of Napoleon. Yet these of the first grade total 120 males to 108 females among the first four born. It is the second grade that happens to have an excess of daughters among the first four (64 to 52 sons). Altogether the proof seems sufficient that the remarkably large families of royalty, — running from five to twelve are not at all, or but very little, correlated with any desire for male heirs. *(To be continued.)*

***Distribution of sexes in Royal Families from the Second Division of the Almanach. For explanation of figures see footnote p. 243.**

Bentheim MMMFFMM *C*; Castell FMMFMMFF *C*; Harrach FMFMMMM *C*; Hohenlohe MMFMFMMMF *C*; Isembourg 1st marriage FF; 2d marriage FFMFFFFF *P*; Königsegg FFFFMMF *P*; Lobkowicz MFMFFFFFM *P*; Lobkowicz FMFFFFF *P*; Lobkowicz FMFMFFFM *P*; Lobkowicz FFFFFMFM *P*; Löwenstein FFFFFFM *P*; Löwenstein FFMFMMFFM *P*; Neipperg MMFMMFM *C*; Ortenbourg MMFFMMM *C*; Platen 1st marriage M, 2d marriage MMMFMMFFFMM *C*; Rechberg FFFFMMFM *P*; Salm MFFMFMFF *P*; Sayn MFFFFMMM *P*; Schönbourg FFMFMFMF *P*; Schönbourg MFFFFFMF *P*; Schwarzenberg MFFFMFF *P*; Solms MMFFFFF *C*; Stolberg MMMMFMFFF *C*; Turn-et-Taxis MMMMFMM *C*; Turn-et-Taxis FFMMFMMF *P*; Trauttmansdorff MFMFMMMFF *C*; Waldbott MFMMMMMF *C*; Waldbourg MFFMFMFM *P*; Windisch-Graetz FMFMMFFMFMF *C*. Total 29. Twelve cases are against the theory that males are especially desired.

TEOSINTE AND THE ORIGIN OF MAIZE

G. W. BEADLE*
School of Biological Sciences, Stanford University

THE manner of origin of maize, an important contribution of the Americas to the crop plants of the world, remains a mystery despite numerous efforts directed toward its clarification. That it originated in the new world is now undisputed. Only two known American genera, Euchlaena and Tripsacum, can be regarded as close relatives of maize, and several attempts have been made to define their relationships to each other and to maize.

Euchlaena mexicana, or annual teosinte, known as a true wild plant only in Guatemala,[6] is similar to maize in having ten pairs of chromosomes. It readily hybridizes with maize, and the resulting hybrids are relatively fertile.[3] Although there are heteromorphic chromosome pairs in the F_1 generation hybrids, there is no evidence that inter-chromosomal translocations played a role in the differentiation of the two forms.[1] In a number of chromosome arms, crossing over is essentially normal between maize and teosinte chromosomes,[4] but it does not occur in at least one segment, namely, the short arm of the ninth chromosome.[2] Genetic analysis of hybrids between maize and annual teosinte indicates that many gene pairs are heterozygous in the F_1 plants,[3] but Mangelsdorf and Reeves[7] have recently obtained evidence that the essential differences are limited in number and can be localized in four or five chromosome segments. Whether or not these differences can be ascribed to as many gene loci is not clear on the basis of published evidence, but the authors just cited favor the view that chromosome segments are concerned. The above facts show that in germ-plasm architecture maize and teosinte are remarkably alike, so much so that placing them in separate genera is perhaps no longer justifiable in spite of the rather wide differences in morphological characters.

Tripsacum, in contrast to Euchlaena, is clearly less closely related to maize. The basic chromosome number in this genus is 18. Mangelsdorf and Reeves[8] found that artificial shortening of maize silks followed by large scale applications of *Tripsacum dactyloides* pollen would produce hybrid seed. Most of these seeds failed to mature. A few were successfully germinated following soaking in water, removal of the pericarps, treatment with a fungicide, and finally placing on sterile agar in Petri dishes kept in the light at a suitable temperature. The F_1 hybrids show little or no pairing of Tripsacum and maize chromosomes, are pollen sterile, but produce viable female gametophytes from unreduced megasporocytes. As female parents, these hybrids have been successfully backcrossed to both maize and Tripsacum. In backcrosses to maize, plants with ten pairs of maize chromosomes plus an extra Tripsacum chromosome have been obtained and there is evidence that in such plants there is occasional interchange of chromatin material between maize and Tripsacum chromosomes.

Theories of Origin

Several hypotheses have been proposed to account for the origin of maize, a plant now quite incapable of maintaining itself in the wild, and it is proposed to consider these in relation to the facts outlined above. Perhaps the simplest hypothesis is that it was selected by man from a wild prototype which is now either extinct or undiscovered. Any hypothesis involving an extinct or unknown ancestor must remain unsatisfactory until tangible evidence for the existence of such a plant is forthcoming. A more serious objection to this hypothesis

*The seeds of Guatemala teosinte used were obtained for another purpose from Mr. J. H. Kempton of the U. S. Department of Agriculture, to whom the writer wishes to express his gratitude.

DID THE AZTECS USE TEOSINTE FOR MAKING "POPCORN"?

Figure 8

Teosinte kernels before and after "popping". From left to right there are two each of unpopped, partially popped, and completely popped kernels. This suggests a possible method by which the American Indians may have used this wild relative of corn for food. With such good reason for an interest in the plant, it may have been exposed to centuries of selection which eventually produced the maize that the early American immigrants found in cultivation.

is that it provides no basis for the extremely close relationship now existing between maize and teosinte. Mangelsdorf and Reeves[7] favor this hypothesis and they would account for the close relationship between teosinte and maize by assuming that teosinte arose through contamination of cultivated maize by the addition of segments of chromosomes of Tripsacum. While this view that teosinte is secondarily derived has points in its favor, the hypothesis still assumes an extinct or undiscovered wild prototype of maize. Furthermore, unless ancient maize was quite different from present day maize at the time of the origin of teosinte through such contamination (probably only about 1,300 years ago, according to Mangelsdorf and Reeves), it appears exceedingly unlikely that the necessary natural hybrids could have occurred spontaneously. The sequence of operations employed by Mangesldorf and Reeves[8] to obtain the F_1 hybrids artificially is such that the natural occurrence of these hybrids would appear to be precluded. In addition, the transferrence of the particular four or five necessary chromosome segments through rare crossing over involves another sequence of events *a priori* improbable Finally, admitting the close relationship between teosinte and maize, it appears to be quite unnecessary to postulate an hypothetical wild prototype of maize which through hybridization with Tripsacum gave rise to teosinte.

Another hypothesis assumes that maize originated through hybridization of teosinte with a species now either extinct or undiscovered. This also has the disadvantages of requiring an unknown ancestor and of not taking into account the genetic similarity of maize and teosinte. This supposition has no obvious advantages and appears to be unnecessary. The suggestion that teosinte, maize and Tripsacum arose independently from a common ancestor, now extinct or unknown, is subject to these same objections.

A Use for Teosinte

Considering the closeness of the genetic relationship between maize and teosinte, there would seem to be no difficulty in assuming, as several workers have, that maize arose directly from teosinte through selection by man. It has been objected that the time required for such an origin would be unreasonably long.[5] Mangelsdorf and Reeves[7] have presented evidence suggesting that the "essential" genetic differences between maize and teosinte can be accounted for on the basis of a four-factor segregation in backcrosses of their F_1 hybrids to maize. The paired pistillate spikelets of maize are dominant to the unpaired ones of teosinte and therefore cannot be followed in such backcrosses; this would presumably bring the number of segre-

gating major factor pairs to five. While the classification of differentiating characteristics into essential and non-essential may be considered somewhat arbitrary, it does appear that the number of major genetic differences between the two species is not as large as might have been supposed from previous work. This would appear to dispose of the objection based on the probable time required to bring about the transformation. It is true that Mangelsdorf and Reeves are inclined to look upon these differences as due to differences in segments of chromosomes, but no direct evidence in favor of this view is presented aside from the statement that certain exceptional plants favor it. These writers are of the opinion that these essential differences between maize and teosinte are the result of contamination of maize with Tripsacum chromatin. The fragmentary circumstantial evidence offered in favor of this interpretation cannot be regarded as convincing, and the writer prefers what appears to him the simpler view that these major differences arose by mutation, either genic or chromosomal in nature, and were preserved by man through deliberate selection.

Another objection to the view that maize arose directly from teosinte through selection by man is that teosinte would offer man little or no encouragement as a food source. Kempton,[5] for example, states, "No more useless grasses from the standpoint of human consumption could be devised than the American relatives of maize." This statement is based on the fact that in both teosinte and Tripsacum the kernels are imbedded in joints of the rachis and further protected by a hard outer glume. This protective covering of the kernel is very hard and bony, especially in teosinte.

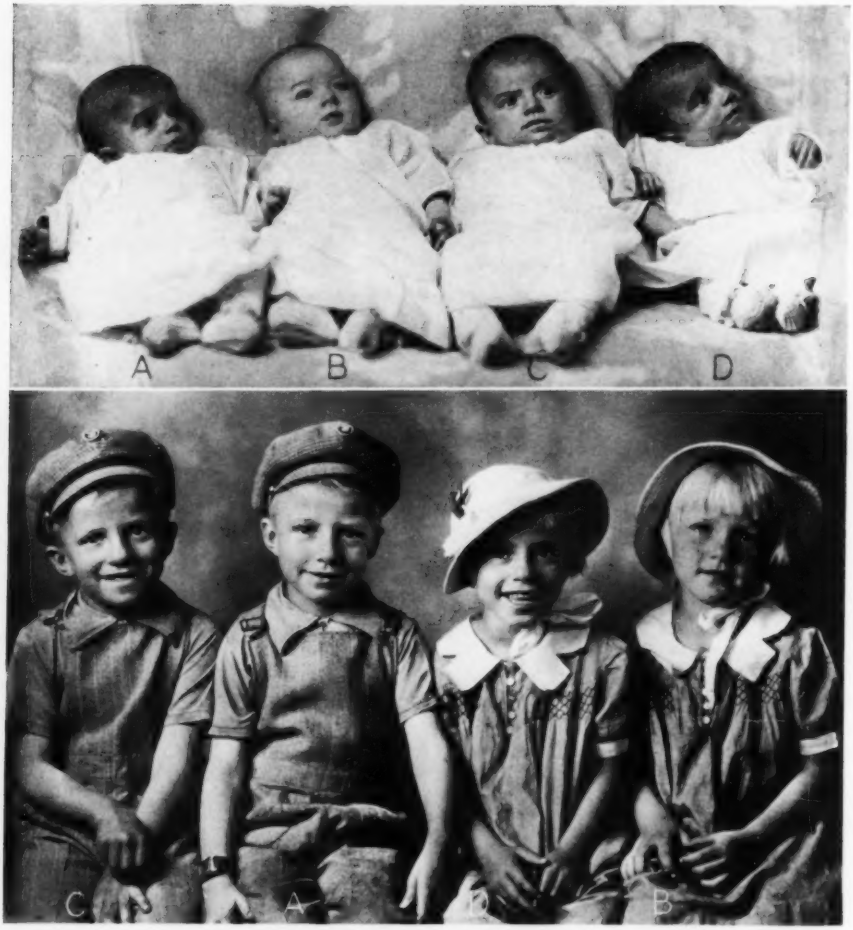
In considering possible means by which teosinte might be used by man, it occurred to the writer to try "popping" it. It is, of course, well known that pop-corn was widely cultivated in the Americas in pre-Columbian times and that the phenomenon of popping was known. The result of heating Guatemala teosinte "seeds" in an ordinary pop-corn popper is indicated in Figure 8. With the proper moisture content, the endosperm explodes with such violence as to remove the kernels completely from the inedible hull. The popped kernels are indistinguishable from ordinary popped maize in taste and are of approximately the same size as the popped kernels of the smallest commercial varieties of pop-corn. Clearly such popping of teosinte provides a simple, easily discoverable, and practicable means of utilizing teosinte as a food plant. The possibility is suggested that this behavior of teosinte was discovered several thousands of years ago, that this provided the incentive for its cultivation, and that, following such cultivation, mutations further increasing the usefulness of the plant as a food source were preserved through selection, and that finally the plant that we now know as maize was developed.

Summary

When subjected to heat, the seeds of teosinte pop in the same way as do kernels of common pop-corn. These popped kernels are entirely separated from the hard inedible hull normally enclosing them and are admirably suited to human consumption. The hypothesis is suggested that prehistoric American man discovered this means of utilizing teosinte as a food plant, developed methods of cultivation for this plant, and over a period of many hundreds of years selected the combination of the five or more major and the many minor gene and chromosome mutations that now distinguish cultivated maize from its presumed wild ancestor.

Literature Cited

1. Beadle, G. W. *Zeitschr. f. indukt. Abstamm. u. Vererb.*, 62, 291-303. 1932.
2. ————. *Genetics*, 17, 481-501. 1932.
3. Collins, G. N. and J. H. Kempton. *Jour. Ag. Res.*, 19, 1-37. 1920.
4. Emerson, R. A. and G. W. Beadle. *Zeitschr. f. indukt. Abstamm. u. Vererb.*, 62, 305-315. 1932.
5. Kempton, J. H. *Smithsonian Report*, 1937, 385-408. 1938.
6. Kempton, J. H. and W. Popenoe. *Carnegie Inst. of Wash. Publ.*, 483, 199-218. 1937.
7. Mangelsdorf, P. C. and R. G. Reeves. *Proc. Nat. Acad. Sci. Wash.*, 24, 303-312. 1938.
8. ————. *Jour. Heredity*, 22, 329-343. 1931.



THE SCHENSE QUADRUPLETS

Figure 9

Photographs of the Schense quadruplets taken at four and one half months (top), and at five years (bottom). In the top picture they are in the order, James (*A*), Joan (*B*), Jay (*C*), and Jean (*D*). In the lower photograph the same letters identify each of them. A study of the x-rays of their hands (Figure 12) indicates that James and Jay are probably "identical twins," but that the girls are "fraternal twins."

NORMAL VARIATIONS IN THE OSSIFICATION OF BONES

Due to Genetic Factors

J. W. PRYOR
Laboratory of Anatomy, University of Kentucky

OVER thirty-two years ago the author made the observation that, "Variation in the ossification of bones is a heritable trait" in the abstract of a paper read at the meeting of the Association of American Anatomists, in Madison, Wisconsin, March, 1907. This had reference only to normal variations, that is, the chronological sequence of ossification of the bones of the carpus and the presence of an extra epiphysis at the proximal end of the second metacarpal bone. I based my conclusions on the study of roentgenograms of the hands of 206 children under seven years of age, 100 female and 106 male. The carpal sequence was noted and tabulated and the size of the shadow given in millimeters. From this list I selected ten families with two or more children. In one family there were three children having the extra epiphysis at the central end of the second metacarpal.

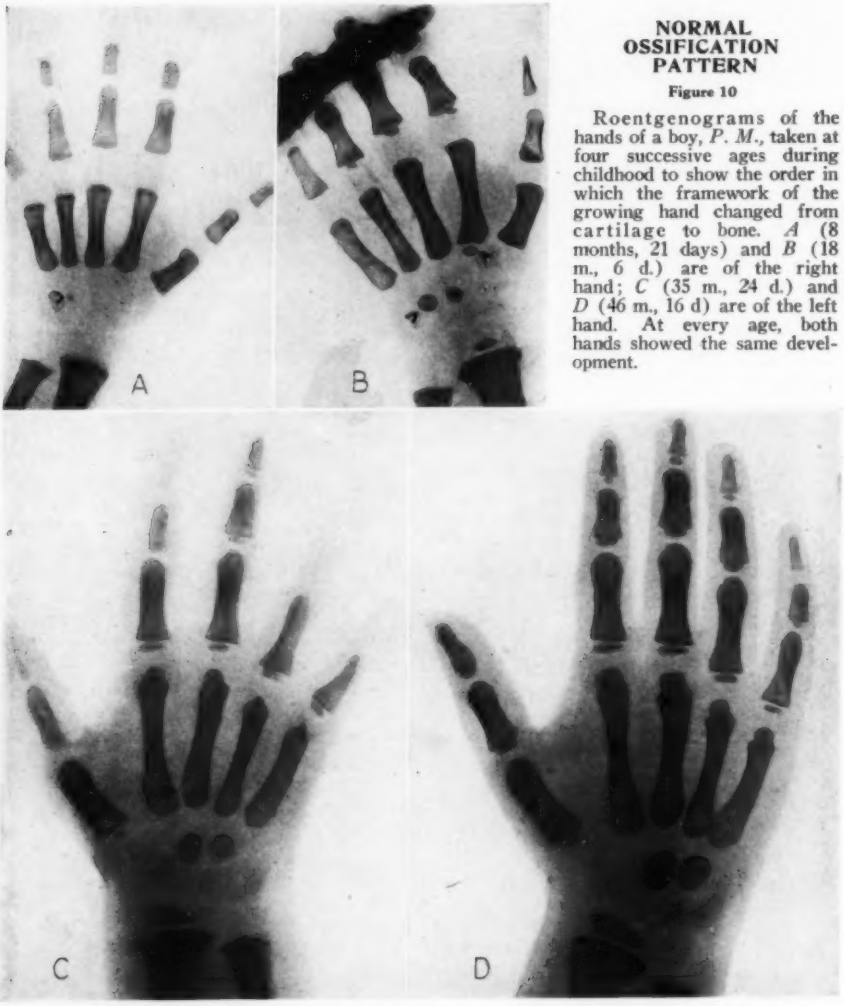
Since that time I have had abundant opportunity to corroborate the statement. Recently the advent of the Dionne quintuplets has inaugurated what might be termed a riot of publicity concerning multiple births and the relation of the identical and fraternal multiple birth to the question of heredity. It had been my pleasure to propose that sequence in which the carpal bones of the hand begin ossification is a genetic character. The large number of these ossification patterns give this character a considerable importance in differentiating multiple births.

While the question hardly comes in the usual field of genetic activity, I doubt whether any geneticist who had considered the evidence would say that carpal sequence of ossification was haphazard. Of course, there is great variation, but it is in no sense erratic. With eight bones to begin ossification at different periods of time, there is opportunity for a vast number of patterns. I am satisfied that these can be classified into distinct types and that these will be found to be inherited in typical Mendelian fashion. The size of the bone does not determine the sequence of ossification. Thus, while the surface area of the hamate is greater than that of the capitate, my research does not give the hamate over five per cent in the first position while the capitate begins ossification earlier than the hamate in ninety-five per cent of my roentgenograms. Other investigators may have found the hamate preceding with a greater frequency.

A more striking illustration is that of the triangular, a smaller bone than the others with the exception of the pisiform and yet in 229 hands the triangular began ossification in the third position 119 times and only ten times in the fourth position and never sooner or later.

Once inaugurated, ossification proceeds with more rapidity in some bones than in others. I am giving a positive illustration of this in the hands of a male child, *P. M.* in Figure 10. This shows the progress of ossification between eight months and nearly four years. At every age, both hands show the same development. At eight months (Figure 10*A*) the hamate has begun ossification in advance of the capitate. At one year and six months (Figure 10*B*) it is still in advance; at two years and eleven months the two bones are almost equal in size, perhaps the hamate a shade larger. Eleven months later (Figure 10*D*) the capitate has overtaken and passed the hamate.

When the navicular is completely os-



NORMAL OSSIFICATION PATTERN

Figure 10

Roentgenograms of the hands of a boy, *P. M.*, taken at four successive ages during childhood to show the order in which the framework of the growing hand changed from cartilage to bone. *A* (8 months, 21 days) and *B* (18 m., 6 d.) are of the right hand; *C* (35 m., 24 d.) and *D* (46 m., 16 d) are of the left hand. At every age, both hands showed the same development.

sified the shadow is almost equal to that of the capitate but I have never found it beginning ossification as soon as the third position.

In seventy-five per cent it will appear in the fifth position three times as often as the greater multangular, which is assigned to the fifth position by some authors. Other investigators may have found the greater multangular preceding the lesser multangular a sufficient number of times to assign it the sixth position.

This paper is to call attention to the evidence that carpal sequence of ossification is a Mendelian character and in certain patterns dominant and in others recessive; that it is not merely by chance that we find the same variations in several members of a family. The gene concept applies to the osseus systems with the same mathematical precision that it

does to the rest of the organism. I am not sure why an extra epiphysis is occasionally found at the central end of the second metacarpal bone but I have observed that in monozygotic multiple births, when present, it will be found in the hands of all regardless of the number. I have found this to be true in identical twins, triplets and quadruplets. More remarkable still, it may be present in fraternal twins or sibs.

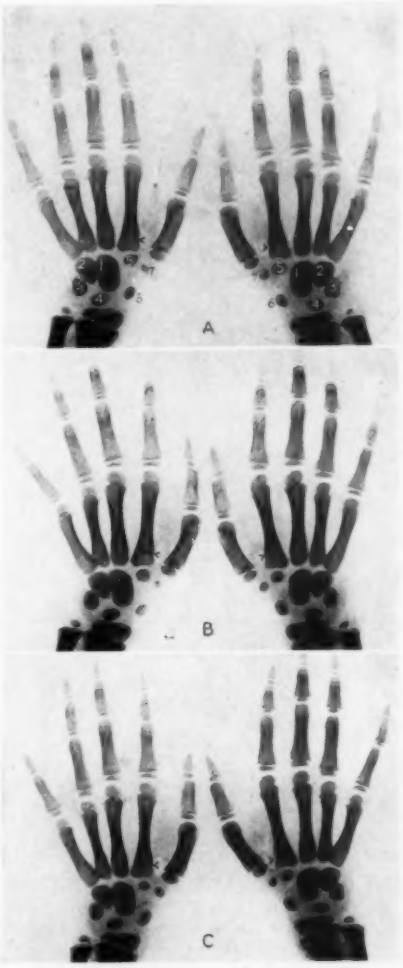
From a study of five sets of triplets Buschke[1] states:

> In the case of triplets the following conclusions are possible:
> 1. All three possess *identical* material.
> 2. All three possess *different* material.
> 3. Two possess the *same* and the third a *different* gene complex.
>
> Those of group one are genotypically identical, are almost always characterized by startling similarities in all observable respects. We can hardly imagine that three individuals could be so much alike in so many characteristics which must depend for their expression on the action of a great number of different genes, unless these individuals originated from the same chromosome mass. All three partners of a trio showing this almost ridiculous similarity must be regarded as having developed from a single zygote through the process of polyembryony.

I am referring to his case 5, of monozygotic female triplets. The roentgenograms of their hands at four and one-half months of age show centers of ossification in the capitate and hamate, the latter a shade larger. This would indicate the hamate began ossification in advance, and that both centers must have begun ossification before birth or shortly after.

These hands at twelve years of age present a very unusual pattern of carpal sequence. Granting that the hamate preceded the capitate it is as follows: 1. hamate, 2. capitate, 3. triangular, 4. lunate, 5. greater multangular, 6. lesser multangular, 7. navicular. This is an extremely rare patatern of carpal ossification. Buschke states, "The development is identical in all three. The order of ossification, as far as it can be judged by the size of the centers is concordant."

Evidently we have here a variation in ossification due to the gene complex and following the same line of development in all six hands.

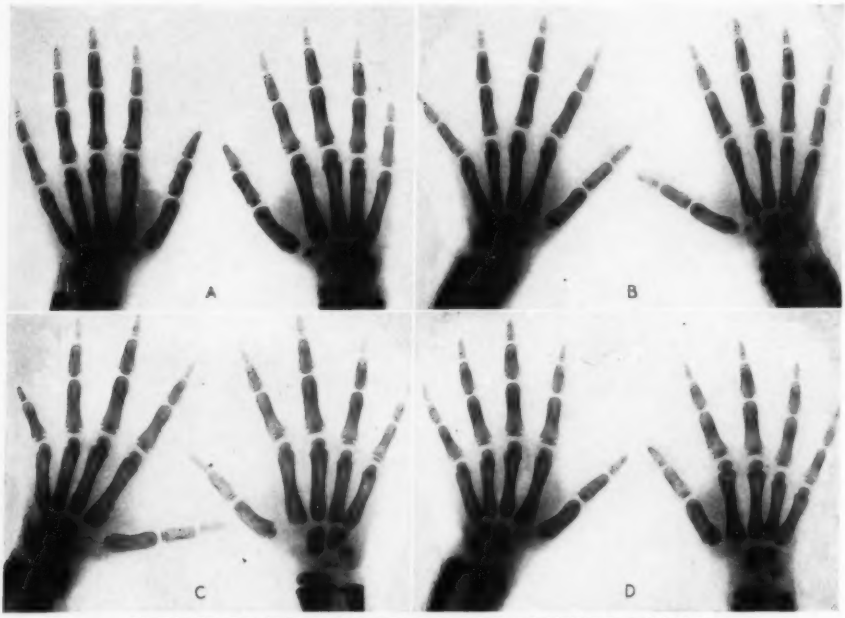


OSSIFICATION PATTERNS OF KERNER TRIPLETS

Figure 11

Roentgenograms of the hands of the Kerner triplets, in all of which the carpal sequence is the same; 1. capitate; 2. hamate; 3. triangular; 4. lunate; 5. lesser multangular; 6. navicular; 7. greater multangular. The hands shown are those of Fred (*A*), John (*B*), and Henry (*C*). The hand-pattern studies confirm the belief that the triplets are identical .

I am indebted to Dr. L. H. Sontag of Yellow Springs, Ohio, for roentgenograms of the hands of the Kerner trip-



X-RAYS OF THE HANDS OF THE SCHENSE QUADS

Figure 12

X-rays showing the differences in ossification of the hand bones of the quadruplets, two of whom are fraternal girls (Figure 9). The ossification sequence of the two boys (*A*, *C*) is: 1, capitate; 2, hamate; 3. triangular; 4. lunate; 5. lesser multangular; 6. greater multangular; 7. navicular. (*C* has the last three missing.) That of the girls is different from this and from each other: Joan (*B*), 1. capitate; 2. hamate; 3. triangular; 4. lesser multangular; 5. greater multangular; 6. navicular; (lunate missing); Jean (*D*) has the lunate in the fourth position, but otherwise is the same as Joan. The x-rays were taken at five and one-half years of age except for that of James (*A*), which was taken 17 months later, so that he shows greater development than his "twin" (*C*). The letters identifying the quadruplets are the same as those on Figure 9, where the quads themselves are shown.

lets, who are monozygotic, dichorionic males (Figure 11).

Dr. Sontag's[6] report did not include the x-rays from which one can see that the bones of the carpus, metacarpus, phalanges and epiphyses are almost concordant notwithstanding the large number of opportunities for asymmetry. The carpal sequence pattern is: 1. capitate; 2. hamate; 3. triangular; 4. lunate; 5. lesser multangular; 6. navicular; 7. greater multangular, which does not correspond to the pattern of the Buschke triplets. The carpal sequence is the same in all six hands. We also find variation in an extra epiphysis at the central end of the second metacarpal bone in all six hands. These findings in ossification not only corroborate Dr. Sontag's diagnosis of identicals but give convincing evidence of the hereditary nature of variations in the ossification of bones. Here we have two normal variations that are quite infrequent, viz., a carpal sequence in which the lesser multangular is in the fifth position preceding the navicular, and an extra epiphysis at the proximal end of the second metcarpal bone which could be only the result of genetic factors which must have been dominant in one of the parents, or transmitted by both of them.

In the Perricone quadruplets the metacarpals, phalanges, and epiphyses are discordant in many respects as to size,

length, etc. The carpal bones are following the same line of development through the lunate with the exception of *C* in which the lunate has not begun ossification. *D* has the navicular in the fifth position and the greater multangular in the sixth while *B* has the lesser multangular in the fifth position. These varying conditions could not come from the chromosomes of a single zygote. They are genotypically different and bear out the diagnosis that they were quadrazygotic in origin.

Through the courtesy of Dr. William D. Farrell, Wells Block, Aberdeen, South Dakota, I am reporting the Schense quadruplets:

May 14, 1938

Please find enclosed x-ray films of the hands of the Schense quadruplets with some data as requested.

These babies were born in St. Luke's Hospital, Aberdeen, South Dakota, on January 13, 1931, about five weeks premature.

The names and order of birth as follows:

James—*A*—
length 16½ inches—weight 3 lbs. 7 ozs.

Jean—*D*—
length 17½ inches—weight 4 lbs. 14 ozs.

Joan—*B*—
length 16½ inches—weight 3 lbs. 11½ ozs.

Jay—*C*—
length 19 inches—weight 4 lbs. 8 ozs.

The mother was in labor four hours and forty minutes.

Baby *A* was delivered by low forceps (vertex).

Baby *D* normal vertex.

Baby *B* manual breech.

Baby *C* normal vertex.

Condition of all the babies at birth was good considering their prematurity. There was one placenta.

The mother was discharged from the hospital two weeks following delivery. The babies were kept five weeks longer. All were kept in incubators for two weeks except James, *A*, who was kept in for three weeks.

At the time of leaving the hospital

James—*A*—weighed 7 pounds 1½ ounces
Jean —*D*—weighed 7 pounds 6 ounces
Joan —*B*—weighed 6 pounds 5 ounces
Jay —*C*—weighed 7 pounds 12 ounces

The babies have progressd rather normally except for being slightly underweight. They started attending school last fall and a psychological examination previous to entering showed a normal I.Q. in all of them.

I hope this brief synopsis will furnish the desired information.

We had some trouble in getting them in for X-ray pictures and then the films of the first three were misplaced and have just been located as you will notice the date on the 4th film was a few weeks later.

(Signed) W. D. Farrell

Later Dr. Farrell gave additional details:

May 18, 1938.

I have your inquiry of May 21, requesting further information regarding the Schense quadruplets.

From indications at birth and existing at the present time, three of the quadruplets, namely, James, Jean and Jay are identicals, as they are all dark skinned and have dark hair and eyes. Joan, however, is definitely blond and from appearances would be classed by herself. The other three all look very much alike.

There are no special peculiarities in any of them.

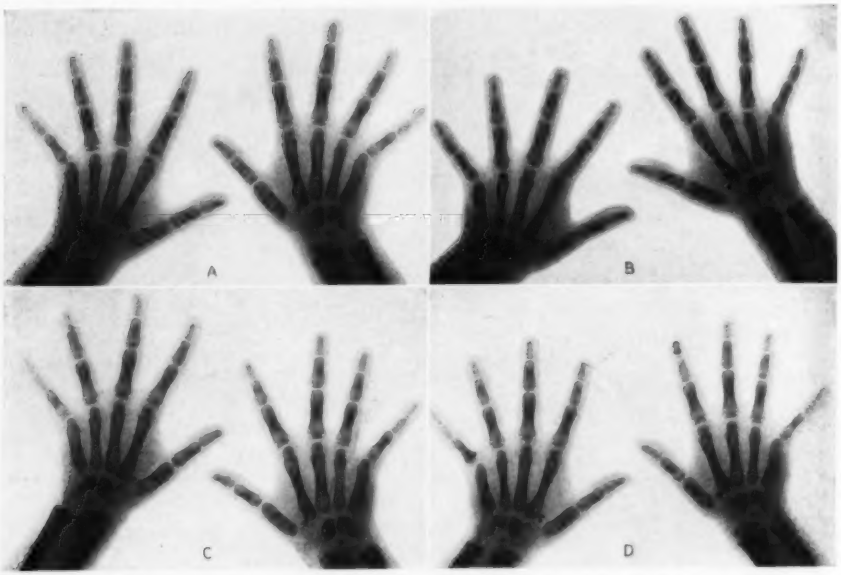
At the time of birth the membranes had ruptured when I arrived at the delivery room. The membranes preceding the birth of the third child, I ruptured. The placenta was as one and it was very difficult for me to determine whether or not there was any fusion. I probably did not examine the placenta as critically as I should have and it was not preserved.

James, *B*, Jean, *D*, and Jay, *C*, all have dark skin, dark eyes and look very much alike in every way. Joan, *B*, is a decided blond, very light hair, fair skin and blue eyes. She does not look like the other three.

(Signed) W. D. Farrell.

The data being incomplete, I would hesitate to give a positive opinion as to the classification of these quads. Much of the evidence, including the x-ray, would indicate they were trizygotic. The boys are possibly twins but the girls are certainly not. The boys and one girl at four and one-half months of age show strong resemblances in features [Figure 9 (top)]. The girl, *B*, is decidedly different. At five years of age [Figure 9 (bottom)] the resemblances and differences are emphasized.

The roentgenograms of the two girls and one boy were made at five and one-half years of age; that of James, *A*, 17 months later. This difference in age must be considered when comparing the boys. The carpal sequence of James, Figure 12*A*, is: 1, capitate; 2. hamate; 3, triangular; 4. lunate; 5. lesser multangular; 6. greater multangular; 7. navicular. Jay, Figure 12*C* follows the same lines through the lunate. The 17 months' difference in the times the films were made accounts for the difference in the extent of the ossification. The metacarpals, pha-



IDENTICAL HANDS OF IDENTICAL QUADRUPLETS

Figure 13

Roentgenograms of the hands of the Morlok quadruplets, who have been found to be identical by all other tests. Except for a slight variation in *B*, any hand could represent the entire eight. All four hands have an extra epiphysis on the central end of the second metacarpal bone, indicated by the caret marks. This is a very rare occurrence, and is a striking demonstration of the similarity of these eight hands.

langes of epiphyses are apparently concordant. This is not convincing evidence of monozygotic origin but it does not offer anything to the contrary.

The carpal sequence of the girls is decidedly different from each other and from that of the boys. That of Joan, Figure 12*B*, is: 1. capitate; 2. hamate; 3. triangular; 4. lesser multangular; 5. greater multangular; 6. navicular in the left hand with the lunate missing. The right hand follows the same line to the lesser multangular, the other two bones do not show beginning ossification. The point of interest in Joan's hands, differing from all the others, is the large center of ossification in the lesser multangular, in the fourth position, and the absence of a center in the lunate. This is a very rare pattern. The carpal sequence in the hands of Jean, Figure 12*D*, has the lunate in the fourth position. In other respects the hands of the two girls are apparently concordant.

Perhaps some time in the future these quads will have a thorough examination with the tests of the diagnostic formula that will classify them beyond dispute.

The placenta must have been multiple and fused. The two sexes would indicate more than one placenta. One could hardly conclude, from their appearance and the hand patterns, that the two girls could be the product of a single zygote. It therefore seems that the Schense quads were tri-zygotic.

The report of Clark[2] supplemented by McArthur,[3] with the addition of my x-ray findings of the Morlok quadruplets[5] would class them genotypically identicals. As they have the same chromosome material we may expect to see identical hand patterns. The Morlok roentgenograms (Figure 13) show that

the development of the bones of the carpus has not proceeded as far as we find it in the average female hand at this age, that is, 5 years and 8 months.

In four sets of quadruplets I have found that the centers of ossification in the bones of the carpus were not as completely developed beyond the lunate as they are in the average female hand. Those of the navicular, the lesser multangular and greater multangular were either absent or mere points of ossification, while in the average female hand these centers are much larger and show more advanced development.

The carpal sequence in the Morlok quads is the same in all eight hands though the lunate with the exception of *W*, who has the lesser multangular in the fourth position. In every other respect all eight hands are absolutely concordant. With five of the carpal bones, five metacarpal, fourteen phalanges and twenty-two epiphyses in each hand, making in all three hundred and sixty-eight points in which differences could be found. This may be considered positive proof of the genetic nature of this trait. In fact, the right hand of *A*, with few exceptions, could easily represent the entire eight.

A most spectacular point is the extra epiphysis at the central end of the second metacarpal bone in all eight hands. I had observed this in brothers and sisters, twins and triplets but had hardly hoped to find it in quadruplets. I do not believe this variation in ossification will be found in more than one family in five hundred. In the normal hand this variation seems to be recessive and only rarely is dominant. In my early studies in 1905-07 I found it in four families. I have attempted following these families, hoping to carry it through several generations. In one family there are two boys and a girl whom I have had under observation for over thirty years. None of the three have married. In two of the other families there have been no children. This is a question that will have to be followed through several generations on both sides of the family in order to come to accurate conclusions.

Summary

1. Variations in carpal sequence or chronological order of ossification is controlled by genetic factors.

2. The presence of an extra epiphysis at the central end of the second metacarpal bone is inherited in a definite manner.

Literature Cited

1. Buschke, Franz. The radiological examination of the skeleton of triplets. *J. Hered.* 26:391-410. 1935.

2. Clark, Alfred E. Identical Quadruplets. *J. Hered.* 23:257-259. 1932.

3. McArthur, John W. Finger, Palm and Sole Prints of Monozygotic Quadruplets. *J. Hered.* 28:147-153. 1937.

4. Pryor, J. W. Hereditary Nature of Variation in Ossification of Bones. *Anat. Rec.* 4:84-88. 1907.

5. ———. Ossification as additional evidence in differentiating identical and fraternals in multiple births. *Am. J. Anat.* 59:409-423. 1936.

6. Sontag, L. H. A Study of Identical Triplets. *J. Hered.* 26:473-480. 1933.

◆

Exhibit Material for the Genetics Congress at Edinburgh

August 23-31, 1939

IN order to facilitate sending exhibit material to the Genetics Congress the following instructions concerning customs and quarantine regulations will be helpful.

Drosophila, Habrobracon and Galleria

Permission has been requested of the English and Scottish authorities for the admission of these insects. If you desire to return to the United States those strains taken to Edinburgh you are requested to list them with Max Kisliuk, Jr., in charge of Foreign Plant Quarantine enforcement for the port of New York, or with the proper foreign plant quarantine official if you are embarking from another port, *before sailing*. Upon returning to the United States it will be necessary to affirm that the strains you are bringing back are identical with those

leaving this country. If it is desired to obtain admission for strains collected in Britain or on the continent permission to do so must be obtained in advance from Mr. E. R. Sasscer, Principal Entomologist, Division of Foreign Plant Quarantine, U. S. Department of Agriculture, Washington, D. C.

Mr. Max Kisliuk, Jr., should be consulted at the port of New York concerning any questions you may have over your material. His address is Room 844, Federal Bldg., Christopher St., N. Y. City. To reach him by phone call Canal 6-2100 and ask for Extension 360 or 361.

Plant Material

Permission has been requested of the Scottish authorities to admit exhibit material into Scotland, after it has been admitted into England by the English quarantine officials, without the formality of an examination at the Scottish border. The Scottish authorities will examine this material at Edinburgh for the presence of injurious pests or diseases. No difficulty will be experienced in securing admission of exhibit material into England provided it is accompanied where necessary by certificates of health prescribed in the Importation of Plant Orders of 1933 and 1938. According to the Plant-Quarantine Import Restrictions of the United Kingdom of Great Britain all living plants and parts thereof imported must be accompanied by two copies of a certificate of a duly authorized official of the phyto-pathological service of the country in which the plants were grown in the form prescribed below:

"This is to certify that (strike out words not applicable) { (the living plants) / (a representative sample of the living plants) } included in the consignment, of which particulars are given below, were/was thoroughly examined on (date) , by (name) , a duly authorized official of the (name of plant protection service) and found to be healthy, no evidence of the presence of any insect, fungus, or pest destructive to agricultural or horticultural crops having been found in them, and that this consignment does not include any plants of the genus Ulmus nor of the following genera of Pinaceae: Abies, Larix, Picea, Pinus, Pseudotsuga, Sequoia, Thuja, and Tsuga, nor plants of sugarbeet and mangold (*Beta vulgaris* L.)."

The inspection referred to in the certificate shall be carried out not more than 14 days prior to the date of shipment. The original of the certificate shall be forwarded by mail by the exporter to the Horticultural Branch of the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S. W. 1, before the plants are shipped. Except in the case of consignments imported by mail, a copy of the prescribed certificate shall be delivered to an officer of Customs and Excise at the same time as, and together with, the entry relating to the consignment. In the case of consignments imported by mail, a copy of the prescribed certificate shall be affixed to each package.

No phytosanitary certificate is required for herbarium specimens or seeds. In other words they can be carried or shipped without the formality of an inspection.

Some doubt has been expressed as to the classification of ears of maize and other cereals and it may be that they will be classed as parts of living plants. It is suggested therefore that a phytosanitary certificate be obtained for this type of material. These certificates may be obtained from state or federal quarantine officials.

Nothing need be done about exhibit material such as photographs or charts.

When it is desired to return plant material of any description to this country it is suggested that a list of this material be left with Mr. Kisliuk before sailing from New York. This will facilitate matters when you land in New York.

Procedure for Scientific Articles or Instruments to be Used for Exhibit or Demonstration Purposes

All exhibitors planning to send scientific instruments or articles should communicate with Prof. F. A. E. Crew at Edinburgh. It is our understanding that Prof. Crew will arrange with the English and Scottish authorities to admit such articles and instruments free of customs duty. In order to avoid duty when this material is returned to the United States you should procede according to the following regulations taken from the Treasury Department's Customs Regulations:

"Articles Exported for Exhibition, Etc."

Article 474. Articles exported for scientific or educational purposes.—Tariff Act of 1930,

(*Continued on page 266*)

SPIKE BLADE -- A HERITABLE SINGLE COMB VARIATION IN THE FOWL*

D. C. WARREN
Kansas Agricultural Experiment Station

THE term spike blade has been applied by the writer to a variation in the form of the blade of the comb found in Single Comb Rhode Island Reds. This variation has been observed also in other single comb varieties of the larger breeds. The blade is that portion of the comb which extends posteriorly from the rear point of attachment to the skull. Its form is ordinarily a broad leaf-like lobe. In the spike-blade variation the blade takes a spike-like form similar to that found on the rose combs. The spike type of blade is not definitely distinguishable from the normal form until maturity is approached so all birds used in this study had to be reared to approximately that stage. The typical spike blade was readily distinguished from the normal but there were found a few intermediate types in which the blade showed varying degrees of thickening, thus sometimes making classification questionable.

The spike blade variation was first observed in several individuals of the flock of S. C. Rhode Island Reds of the Kansas State Agricultural Experiment Station in 1926. The strain exhibiting this character is no longer carried at this institution and although the genetic analysis is not complete, the data are being published to record the results for workers who may encounter this condition in other flocks.

Matings

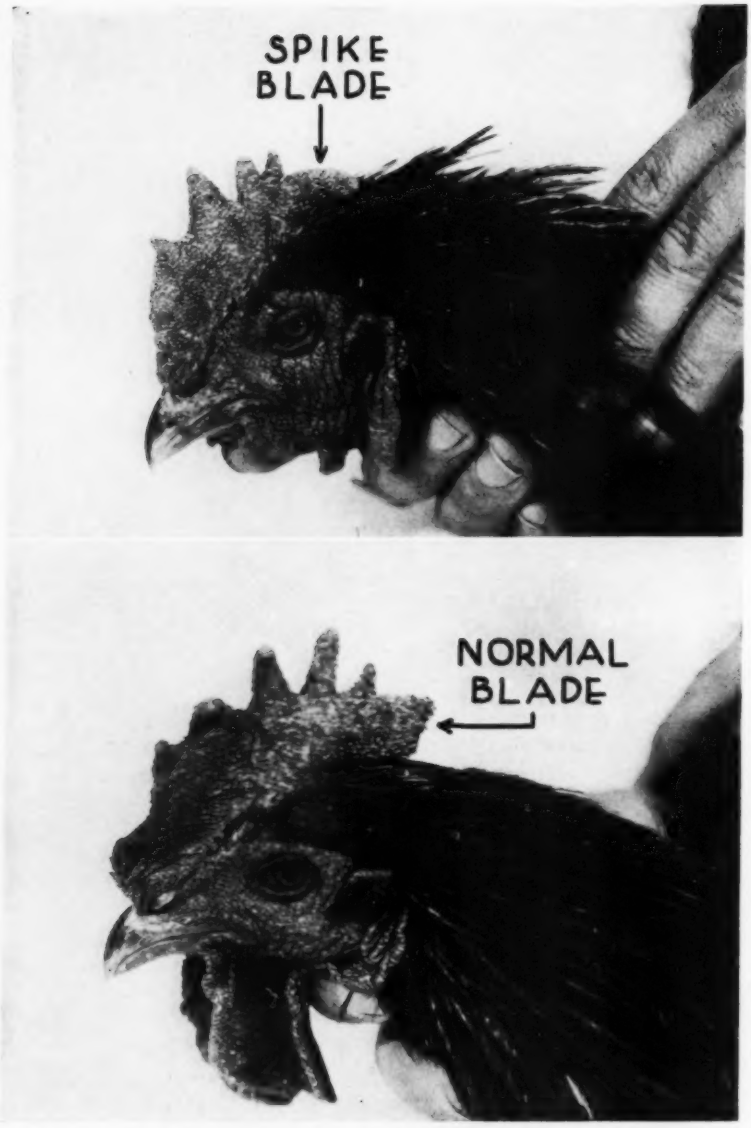
From among the early observed individuals with this character a male with a typical spike blade was mated to six females with the same type. For five of them practically all of the offspring were spiked, the totals (Table I, 938M) being for females—two intermediate blades and 22 spikes; and for males—one intermediate and 13 spikes. The sixth female produced about equal number of spikes and normals (7:8) among her daughters and five spikes to two normals among her male offspring.

From this mating typical spike blades were again mated but excluding the offspring of the one female that gave a considerable number of normals. The results (Table I, 980M) were 43 females all of the spike-blade type and 59 males of which 51 were spike-blades and eight normal. The eight normal males were from several different females so that it would appear that some individuals which have the genetic constitution do not show the spike-blade condition.

The same spike-blade male which gave such a high percentage of spikes when mated to spike-blade females, was also mated (Table II, 980M) to normal-bladed females. These females not only showed normal blades but came from large families which had no spikes. The results of this F_1 generation were three spiked to 15 normal females and three spiked to two intermediates and 23 normal males. The small number of spikes in this generation are difficult to account for except on the basis of incomplete dominance of normal blades.

Another male (Table II, 975M) with a spike blade and coming from parents that had this type of blade was mated to normal-bladed females. No attention had been paid to the type of blades carried by the parents of the females used. Some of the females must have been heterozygous for spike blade since many more spikes were obtained here than in the

*Contribution No. 115, Department of Poultry Husbandry, Kansas Agricultural Experimental Station, Manhattan, Kansas.



SPIKE-BLADE—A NEW COMB TYPE

Figure 14

Spike blade is a new variation observed in the Rhode Island Red breed at the Kansas State Agricultural Station. Data available indicate that "Spike" is recessive to normal, but with more females affected than males. This appears not to be due to sex-linkage.

other mating of spike-blade male to normal females.

Matings were also made between spike-blade females and normal males (Table II). Two different normal males were used with the following results: 1019M produced 17 daughters of which 13 were normal, one intermediate, and three spiked, while of the 15 sons, 13 were normal, one was spiked, and one intermediate. Male 1021M produced 26 normal, three intermediate, and nine spiked daughters while the 36 sons were all normal except one.

It will be noted that in all matings recorded there is a lower percentage of spike blades among the males than among the females. Since spike blade has behaved more like a recessive this difference might have been interpreted as indicative of sex linkage in the cross of spike-blade male to normal females, but since the same sexual difference was found in mating of spike by spike and especially in the case of the reciprocal mating it can be said that there is no sex-linkage involved. It will be noted that the percentage of spike blades appearing in this cross is very similar to that from its reciprocal.

Attention should also be called to the matings between spike-blade male and spike-blade females from unselected stock (Table I, 938M, 975M, and 990M). These did not produce the same high percentage of spikes as did the selected matings. In spite of the fact that spike blade behaves more like a recessive, the above matings would indicate that all spikes are not homozygous or that there exists some modifier of spike blade which suppresses its expression.

Backcross data are available using both F_1 generation males and females and the two parental stocks. In the matings crossing F_1 females to spike-blade males (Table III) the total results of three matings were for females—30 normals, six intermediates and 34 spikes; and for the males—30 normals, six intermediates and 32 spikes. In the backcross of F_1 generation males to spiked females the totals were for females—21 normals, two intermediates and 19 spikes; and for males—33 normals, three intermediates and eight spikes. Here the females were about equally divided between normals and spikes as would be expected from a monohybrid situation. The backcross to the normal stock gave a high percentage of normals as should result if spike blade behaved as a recessive.

TABLE I. Matings of Spike-Blade Males by Spike-Blade Females

Male No.	Daughters			Sons		
	Normals	Intermediates	Spikes	Normals	Intermediates	Spikes
938M	0	2	22	0	1	13
990M	0	0	45	7	1	21
Spikes from unselected matings						
938M 975M 990M	14	1	12	9	1	3

TABLE II. Matings of Spike-Blades to Normals

Spike-blade male by normal-blade females						
Male No.	Daughters			Sons		
	Normals	Intermediates	Spikes	Normals	Intermediates	Spikes
990M	15	0	3	23	2	3
975M	27	9	33	27	3	6
Normal-blade male by spike-blade female						
1019M	13	1	3	13	1	1
1021M	23	3	9	35	0	1

TABLE III. Backcross Generation

F_1 females (normals) to spike-blade males						
Male No.	Daughters			Sons		
	Normals	Intermediates	Spikes	Normals	Intermediates	Spikes
1029M	8	2	16	5	0	25
938M	6	3	9	8	3	1
975M	16	1	9	17	3	6
Total	30	6	34	30	6	32
F_1 males (normal) to spike-blade females						
1029M	9	1	11	18	1	7
1029M	12	1	8	15	2	1
Total	21	2	19	33	3	8
F_1 male (normal) to normal-blade females						
1029M	27	6	2	32	0	0

Conclusions

The general results of the foregoing matings were as follows:

1. In practically all matings the ratio of spikes to normals was higher in females than in males.

2. The selected matings of spike to spike gave practically 100 per cent spike-bladed females and varying percentages of this type of males.

3. The foregoing results would indicate that spike blade is recessive to normal and this theory is strengthened by the fact that occasional spike blades appear in many matings of normal to normal.

4. There appears to be no difference in the results of reciprocal crosses between spikes and normals, — indicating the lack of influence of sex-linked factors.

5. A large majority of the F_1 individuals were normal as would be the case if spike blade is recessive. However, a few spikes appear in most F_1 generation matings but not in large enough numbers to indicate that any of the supposed normal parents were heterozygous.

6. Some matings of spiked to spiked gave almost half the offspring normal. This result is difficult to account for on the assumption that spike is recessive unless we hold that some of these spikes are really heterozygotes similar to the occasional spikes appearing in the F_1 generation. If selection was exercised practically true breeding spike blades were secured.

7. The results of backcrosses of normal F_1 individuals to spikes support the view that spike blade is a recessive since the ratio of spikes to normals was approximately one to one. As usual there was a shortage of spike-blade males here.

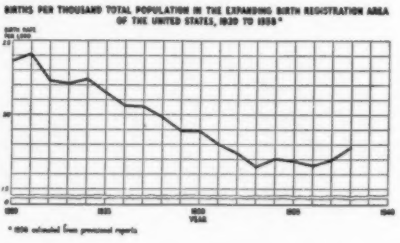
8. The general conclusion is that the major factor conditioning spike blade is recessive with occasional tendency for incomplete dominance of the normal. There are also instances where individuals homozygous for spike blade fail to give expression to the character, possibly as the result of the action of genetic modifiers.

DECLINING BIRTH RATE HALTS

AFTER a period of at least two decades of rapidly declining birth rates, the recent upturn in our figures for 1937 and 1938 encourages the hope that the downward course has at last been halted. Provisional data relating to the general population of the United States point to a birth rate of 17.8 per 1,000 for 1938, which sets a record in several respects. As compared with previous years, the rate for 1938 will be higher than that of any year since 1931. As compared with the lowest rate on record, namely, that for 1933, it shows an increase of 7.9 per cent. * * * The Scandinavian countries, the Baltic countries, England and Wales, northern Ireland, Australia, New Zealand, and the Union of South Africa, all have shown increases in their birth rates in recent years, although no special official steps have been taken in any of these countries to stimulate the birth rate, as has been done in Germany.

* * *

It is also noteworthy that the countries, other than the Scandinavian and Baltic, with recent upswings in their birth rates, belong to the English-speaking group. In England and Wales the birth rate rose from a low of 14.4 per 1,000 in 1933 to 14.9 in 1937; the movement in northern Ireland was from 19.2 in 1935 to 20.0 in 1936 and 19.8 in 1937. Australia's figure went from 16.4 per 1.000 in 1934 to 17.4 in 1937; that for New Zealand



from 16.1 in 1935 to 17.3 in 1937; for the Union of South Africa (European population) the change was from a low of 23.3 in 1934 to a rate of 25.1 per 1,000 in 1937.

With a few exceptions, the foregoing countries reached the low points in their annual birth rates in 1933 or 1934, when the world was still in the throes of a widespread economic depression; their highest points since then have generally been in 1937, the latest year of record for them. For the United States, too, the low point was in 1933; the upward movement has continued into 1938.

Perhaps there is in these figures an indication that in some degree, at least, improvement in economic conditions may tend to bring about an increase in the birth rate. — *Statis. Bull. Met. Life Ins. Co.*, Feb., 1939.

HERMAPHRODISM IN MILK GOATS

O. N. Eaton and V. L. Simmons*

HERMAPHRODISM or intersexuality occurs more frequently in goats than in any other farm animal, yet there seem to be no accurate data on its actual frequency. Most animals reported as hermaphrodites are not true hermaphrodites, but exhibit a condition known as pseudohermaphrodism; i.e., the external genitalia resemble those of both sexes, while the internal genital organs are usually of one sex, either male or female. Since hermaphrodites do not breed, they are a total loss except for their value as meat. Little seems to have been done toward the control of hermaphrodism through breeding, though several authors seem assured that it has a genetic basis, among them Lillie,[10] Crew and Dighton,[5] Buchanan Smith,[4] Brambell,[3] Allen[2] and Ott.[13] Ott also mentions a high percentage of sterility in bucks which are born twin to a hermaphrodite.

There seems to be some disagreement as to the sexual nature of the hermaphrodite. Crew[6] considered all hermaphrodites as males, while Witschi (quoted by Allen) considers them genetically females. Most writers consider goat hermaphrodites as differing from the free martin of cattle, since the former are not necessarily born as a co-twin to a male and the chorionic membranes are not always fused. Keller and Tandler[9] reported fused chorions in goat twins, but there was no anastomosis of the blood vessels.

Material and Methods

This study concerns the herd of milk goats maintained by the Animal Husbandry Division of the U. S. Department of Agriculture at the National Agricultural Research Center, Beltsville, Md. This herd is composed of animals of the Toggenburg and Saanen breeds. Hermaphrodism has occurred almost every kidding season, and the tendency has seemed to increase during the last three or four years. In an attempt to determine if there is an hereditary basis for this condition and, if so, to suggest means for elimination of the character, a study of the records from 1925 through the 1938 kidding season has been made. This investigation includes the number born during each parturition, the sex, birth weight, mortality, and breeding lines in the herd. During the 1938 season, an anatomical study was made of all hermaphrodite kids, which were sacrificed at ten days of age. The detailed anatomical findings, however, are not included in this report.

Frequency of Hermaphrodites

During the period studied there were 343 kids produced in the Saanen herd, of which 38 were hermaphrodites, making a percentage of 11.1. In the Toggenburgs there were 21 hermaphrodites among 350 kids born, or six per cent. A study of individual matings in both breeds reveals that some bucks and does produced no hermaphrodites, while others produced them consistently in certain matings. Among the Saanens, eight does produced hermaphrodites in two or more successive years when mated to the same or to different bucks, and among the Toggenburgs three does produced hermaphrodites in successive years, two of them by the same buck each year. These facts point strongly to an hereditary basis for the occurrence of hermaphrodism.

Since normal animals produce hermaphrodites, hermaphrodism may be regarded as recessive to normal. The normal animals which produce hermaphrodites must be heterozygous for this character. All the bucks used in the Saanen

*We wish to thank Dr. W. V. Lambert, Dr. R. G. Schott, and Mr. D. A. Spencer for suggestions and helpful criticism.

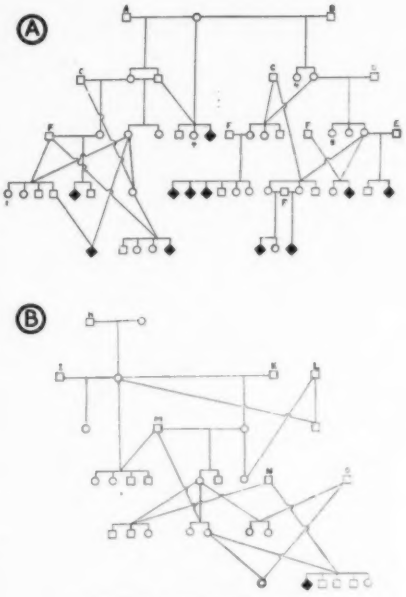
herd sired hermaphrodites, but several does and their progeny through three or four generations appear to have been free from the defect. In the Toggenburg herd there were four bucks and several females apparently free from the defect. Animals which did not produce hermaphrodites have been designated as free; those which produced hermaphrodites are called carriers. Tabulation of the different types of matings according to this designation gave the results shown in Table I.

In the carrier × carrier matings the ratio of normals to hermaphrodites does not depart significantliy from 3:1, as indicated by the p values in Table I, suggesting a single recessive gene as the genetic explanation of hermaphrodism.

Because of the small number of progeny from many of the does, it is probable that some of the so-called free ones were really heterozygous. To check on this an estimate was made of the number of hermaphrodites which should be produced if hermaphrodism is due to a monogenic recessive and if the population were at equilibrium. If *HH* is used to designate free does and *Hh* carriers, there should be 1 *HH* : 2 *Hh* does in a population at equilibrium. These does when mated to *Hh* bucks should produce 5 normals : 1 hermaphrodite. The ratio observed in the Saanens, however, was 8 : 1 (305 normals : 38 hermaphrodites). This ratio would be obtained if *HH* and *Hh* does occurred in nearly equal numbers (5 : 4).

The conditions in the Toggenburg herd were somewhat different. There were four bucks apparently *HH* and nine known to be *Hh*. Most of the does were apparently *HH*. Six per cent of hermaphrodites appeared in this population from all matings. This would be the expectation if the does in the population were approximately in the ratio of 2 *HH* : 1 *Hh*. Progeny of apparently free does when mated to *Hh* bucks should produce 10.5 per cent of hermaphrodites. The percentage observed was 9.1, which does not depart greatly from expectation.

The progeny from a single mating are usually too few to justify conclusions.



BISEX INHERITANCE

Figure 15

Pedigrees demonstrating the recessive inheritance of hermaphrodism. All herd bucks are designated by a letter and all those in pedigree *A* were known to be heterozygous for hermaphrodism except bucks *A* and *C*. All of *A*'s six offspring were normal. Buck *C* produced 21 normal young and is probably a homozygous normal. The hermaphrodism appearing in the sixth generation in pedigree *B* was probably introduced by bucks *M* and *N*. Both were outcrosses with the hermaphrodite-bearing line. Buck *M* was both sire and grandsire of the dam of the hermaphrodite. The female in the first generation of this pedigree is known to be heterozygous for hermaphrodism, since she produced one hermaphrodite when mated with her son.

However, one Saanen buck and his son when mated to eight of their daughters produced 27 kids, of which 20 were normal and seven were hermaphroditic (25.9 per cent). Only two of these daughters produced no hermaphrodites. A study was made of the progeny of daughters of the Saanen bucks. Of 45 daughters mated, 20 produced hermaphrodites in the ratio of 102 normals : 32 hermaphrodites, or 23.9 per cent, which is close to the expected 25 per cent if a single reces-

sive factor is involved. In the Toggenburg herd 47.6 per cent of the hermaphrodites were produced in a line descended from a single female heterozygous for hermaphrodism. Typical pedigrees for free and carrier animals are shown in Figure 15.

Number at Birth

It is well-known that goats frequently produce twins or triplets. The incidence of single and multiple births is shown in Table II.

Both breeds are about equal in the proportion of single births. The Toggenburgs have a considerably higher frequency of twins while the Saanens exceed in triplet births, and once during the period produced a set of quadruplets. Differences in average litter size between the two breeds are not significant.

The Sex Ratio

Various sex ratios have been reported for goats. Howland[7] reported 139 males to 100 females in Toggenburgs for a 20-year period. Addington and Cunningham[1] of the New Mexico station reported 115 males per 100 females for the same breed over a five-year period. Lush, Jones, and Dameron[12] reported 50.1 per cent males out of 3,165 kids born among Angora goats. The proportions of males, females, and hermaphrodites for different sizes of litters in the U. S. D. A. herd are given in Table III.

From these results it appears that the large difference between percentage of males and females among the Saanens could be accounted for by the percentage of hermaphrodites, assuming that hermaphrodites are imperfect females. The ratio of the sexes in the Toggenburgs is near equality as it stands.

However, anatomical examination of seven Saanen and two Toggenburg hermaphrodites of the 1938 season showed that five (four Saanen and one Toggenburg) apparently were females, and four (three Saanen and one Toggenburg) apparently males. Applying this 5 : 4 ratio to the normal males and females, the corrected ratio would stand about 54 per cent males and 46 per cent females in the Saanen, and about 50 per cent of each sex in the Toggenburg breed. In some years, viz., 1926, 1932, and 1936, the number of normal males was more than twice the number of normal females in the Saanen breed.

In 1926 the buck used was in service only that year. The buck in service in 1932 was also used in 1931 and 1933, and the one used in 1936 was in service in 1935 and 1937. The two three-year periods taken together in which the latter two bucks were used still showed a considerable excess of males, though for the years 1931, 1933, 1935, and 1937, there was more nearly equality of the two sexes. Possibly these three bucks had a tendency to produce a higher percentage of males. In nine of the 14 years studied, females exceeded males in the Toggenburg breed. This makes it seem more likely that there is a real difference in sex ratio between the breeds, which, according to the chi-square test, is significant.

The proportion of males rises slightly for twin births, then decreases for triplets. This differs slightly from the data for cattle presented by Johansson,[8] who reported 51.5, 48.8, and 45.9 per cent males for single, twin, and triplet births respectively.

The percentage of hermaphrodites is considerably higher in the Saanen than in the Toggenburg goats observed. In the Saanens, the percentage of hermaphrodism is practically equal for single and twin births, but much higher among triplets. The reverse is true for the Toggenburgs, where hermaphrodism occurs with about equal frequency in twins and triplets but more frequently in single births.

Observations of the Beltsville herd lead to the belief that in multiple births hermaphrodites occur more frequently when the normal young are males than when females. A study of the records shows that 34 males and 23 females were born with a hermaphrodite litter mate. This proportion is slightly higher than the ratio of males for the two herds but is not statistically significant.

Birth Weight of Kids

The influence of litter size on birth weight is shown in Table IV.

Kids of both breeds are nearly equal in birth weight. On the average males are slightly heavier than females. The weights exceed those for Toggenburgs reported by Addington and Cunningham[1]

TABLE I. Progeny of Saanen and Toggenburg goats from free and carrier animals.

Type of mating	No. normal kids	No. hermaph-rodites	Percent hermaph-rodites	Chi-square	P value
Saanen					
10 bucks (carriers) x 40 does (free)	155				
10 bucks (carriers) x 25 does (carriers)	180	38	20.3	2.194	.14
Toggenburg					
4 bucks (free) x 16 does (free)	29				
2 bucks (free) x 5 does (carriers)	12				
9 bucks (carriers) x 61 does (free)	191				
9 bucks (carriers) x 17 does (carriers)	74	21	22.1	.424	.52
Total (carriers x carriers)	224	59	20.4	2.601	.11

TABLE II. The frequency of single, twin and triplet births in goats in the U. S. D. A. herd during the years 1925 to 1930, inclusive.

Type of Birth	Saanen			Toggenburg			Percent of young (total)
	Number	Percent of pregnancies	Percent of young	Number	Percent of pregnancies	Percent of young	
Single	53	28.9	15.2	60	30.4	16.9	16.1
Twins	99	53.9	56.9	116	58.9	65.3	61.2
Triplets	31	16.8	26.7	21	10.7	17.7	22.2
Quadruplets	1	0.5	1.1	--	--	--	.6
Total	184	99.9	99.9	197	100.0	99.9	100.1

TABLE III. The sex ratio observed in goats in the U. S. D. A. herd.

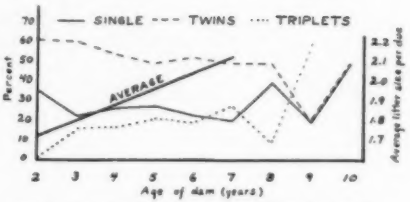
Type of Birth	Saanen			Toggenburg			Size of population (both breeds)
	Percent males	Percent females	Percent hermaph-rodites	Percent males	Percent females	Percent hermaph-rodites	
Single	50.0	43.4	9.6	46.6	43.1	10.3	113
Twins	50.5	39.7	9.8	48.7	46.4	4.9	430
Triplets	44.2	39.7	15.1	39.1	55.6	5.3	186
Quadruplets	50.0	50.0	0.0	--	--	--	4
Total young	49.3	39.6	11.0	46.4	47.6	6.0	733

TABLE IV. Birth weight of kids.

Type of Birth	Saanen				Toggenburg			
	Males lbs.	Females lbs.	Hermaph-rodites lbs.	Dead kids lbs.	Males lbs.	Females lbs.	Hermaph-rodites lbs.	Dead kids lbs.
Single	8.9	8.2	7.9	6.4	8.4	8.1	8.9	4.8
Twins	7.8	7.0	7.0	6.2	7.6	6.8	7.7	5.1
Triplets	7.2	6.4	6.0	5.7	6.9	7.0	6.4	4.9
Average all young	7.9	7.1	6.8	6.9	7.7	7.0	7.8	5.0

TABLE V. Mortality among goat kids.

Type of Birth	Saanen	Toggenburg
	percent born dead	percent born dead
Single births	11.3	6.3
Twins	4.0	6.9
Triplets	17.2	9.5
Average for herd	8.6	7.6



OLDER DAMS HAVE MORE KIDS

Figure 16

Chart showing the relation of the age of the dam to the number of young born. The proportion of triplets increases with the age of the dam.

of the New Mexico Station. Differences in weight due to number at birth are significant in all cases for both breeds. Those dead at birth are significantly lighter in weight than those born alive.

Mortality at and Preceding Birth

In determining mortality only still births and abortions have been considered. The number dying after birth has been exceedingly small.

In both breeds mortality is greatest among triplets and lowest among twins. The Saanens show slightly higher mortality than the Toggenburgs. None of the hermaphrodites in the Toggenburg breed were born dead and in the Saanens only three were born dead, which amounts to 0.86 per cent of all kids born in that breed. Thus, there is no evidence of a differential viability between normal and hermaphroditic kids.

Age of Dam and Number of Young

Voorhies[14] of the California Station and Addington and Cunningham[1] of New Mexico report that older does produce more kids than the younger does. This is confirmed by the results found in the U. S. D. A. herd (Figure 16).

The percentages after seven years of age mean very little since there were only a few does in these age groups. Up to this age the percentage of singles and twins decreases slightly as the does become older, while the percentage of triplets shows a marked rise. This is true for both breeds and agrees with Johansson's[8] data for cattle.

Age of dam has no effect on sex ratio

or on percentage of hermaphrodites, since these remain practically constant for each age group.

Discussion

While the genetic basis for the occurrence of hermaphrodism would seem to be principally a single recessive gene, the possible role of other factors, particularly the endocrines, should not be overlooked. The work of Lillie[10,11] in explaining the free-martin in cattle focused attention on the sex hormones and the part they play in the development of the sex organs. Hermaphrodism in goats is not strictly comparable with the free-martin of cattle. For the production of a free-martin there must exist a female co-twin to a male, but this condition is not fulfilled in the goat, where hermaphrodites occur with either sex.

The gene for hermaphrodism probably exerts its primary influence on the endocrine system during sex differentiation, and thus is only secondarily responsible for the appearance of hermaphrodites. The failure of hermaphrodites to appear in numbers closer to expectation may be due to threshold effects, either of the hormone itself or of the period of activity of the proper hormone. However, further investigation is necessary before a definite statement can be made regarding the exact mode of inheritance of this abnormality.

If this genetic explanation is true, then the condition is transmitted only by heterozygous individuals, since the homozygous hermaphrodites are nonbreeders. By eliminating those animals which have produced hermaphrodites it should be possible eventually to obtain a herd practically free from the defect. Free animals mated to carriers may preserve the defect for many generations.

Goat registry associations and breeders should recognize the importance of reporting all hermaphrodite kids in order that the genetic constitution of breeding animals may be better known, and thus aid in eliminating or grealty reducing the occurrence of this defect in goat herds.

Summary and Conclusions

Analysis is made of the occurrence of hermaphrodites in a Saanen and a Toggenburg herd of goats maintained at the U. S. D. A. laboratories, Beltsville, Md.

Since 1925 the Saanens have produced 11.1 per cent of hermaphrodites and the Toggenburgs 6.0 per cent.

In the Saanens approximately 9.5 per cent of the young born as single or twins are hermaphrodites, while 15 per cent of the triplets are hermaphrodites. In the Toggenburgs 10 per cent of the single kids are hermaphrodites while between four and six per cent of twins and triplets are similarly affected.

More than half the young (56.9 per cent) are born as twins in the Saanen herd while 65 per cent in the Toggenburgs are twins. Almost twice as many triplets as singles are born in the Saanen herd, while the percentage of each in the Toggenburgs is about equal. There is no relation between type of birth and hermaphrodism.

Hermaphrodites appear more frequently as sibs with males than with females but they also occur singly.

Birth weight is more dependent on the number born than on sex. The weight of hermaphrodites is practically the same as that of normal kids.

Still births and abortions occur to the extent of about eight per cent in both breeds. Death at birth among hermaphrodites was lower than for normal kids.

There is a tendency for more triplets as the doe's age increases. This is true for both Saanens and Toggenburgs. Age of dam has no effect on sex ratio or on percentage of hermaphrodites.

From the data presented, hermaphrodism appears to be inherited as a single recessive character. Further study is necessary, however, to confirm this.

Since the development of intersexuality is largely dependent on the action of the sex hormones, the genetic factors concerned probably cause delayed gonadic development and delayed or insufficient secretion of the proper hormone at the critical periods of sexual differentiation.

Elimination from the herd of animals

which produce hermaphrodites would be helpful in checking the occurrence of this abnormality.

Literature Cited

1. Addington, L. H., and O. C. Cunningham. Milk Goat Breeding. *N. Mex. Agr. Exp. Sta. Bull.* 229. 1935.
2. Allen, Edgar. Sex and Internal Secretions. Williams and Wilkins Co., Baltimore. Especially chapters 4, 5, 9. 1932.
3. Brambell, F. W. Rogers. The histology of a hermaphrodite pig and its developmental significance. *J. Anat.* 63:397-407. 1929.
4. Buchanan Smith, A. D. Research in goat breeding. Brit. Goat Soc. Year Book, pp. 78-82. 1926.
5. Crew, F. A. E., and Adair Dighton. Developmental intersexuality in the domesticated goat. *Vet. Jour.* 79:135-139. 1923.
6. Crew, F. A. E. Developmental intersexuality in the goat. *Brit. Goat Soc. Year Book*, pp. 61-64. 1923.
7. Howland, Winthrop. Relative sex-frequency of issue from pure Toggenburg goats. *Goat World* 9:3, 4. 1924.
8. Johansson, Ivar. The sex ratio and multiple births in cattle. *Zeitschr. Züchtung.* B. 24:183-268. 1932.
9. Keller, Karl, and Julius Tandler. Uber des Verhalten der Eihäute bei der Zwillungsträchtigkeit des Rindes. Untersuchungen über die Entstehungsursache der geschlechtlichen Unterentwicklung von weiblichen Zwillingskälbern, welche einen männlichen Kalbe zur Entwicklung gelangen. *Wiener Tierärztl. Wochenschr.* 3:513-526. 1916.
10. Lillie, F. R. The free-martin. A study of the action of sex-hormones in the foetal life of cattle. *Jour. Exp. Zool.* 23:271-452. 1917.
11. ———. Supplementary notes on twins in cattle. *Biol. Bull.* 44:47-48. 1923.
12. Lush, Jay L., J. M. Jones, and W. H. Dameron. The inheritance of cryptorchidism in goats. *Texas Agr. Expt. Sta. Bull.* 407. 1930.
13. Ott, F. Uber die erbliche Bedingtheit der Unfruchtbarkeit der Ziegenlammböcke. *Züchtungskunde* 12:460-468. 1937.
14. Voorhies, Edwin C. The milch goat in California. *Calf. Agr. Expt. Sta. Bull.* 285:87-114. 1917.

◆

Exhibit Material for the Genetics Congress at Edinburgh

(*Continued from page 256*)

as amended by the Act of March 4, 1933, paragraph 1815.

Articles, when returned after having been loaned and exported for use temporarily abroad solely for exhibition, examination, or experimentation, for scientific or educational purposes, if imported by or for the account of the person who exported them from the United States, and not for sale, subject to such regulations as the Secretary of the Treasury shall prescribe.

Article 475. Procedure on entry.— (a) There shall be required in connection with each entry covering such articles, irrespective of the value of the shipment:

(1) A certificate of exportation, customs Form 4467.

(2) A declaration made by the foreign shipper before the United States consul, on a modified consular Form 204, stating that such articles were sent from the United States solely for temporary scientific or educational use, and the use made of the articles.

(3) A declaration of the ultimate consignee in substantially the following form:

District No. ....., Port of .....
Collector's Office, ... 19 ..

I, ..., declare under oath that the several articles described in the annexed entry are, to the best of my knowledge and belief, the identical articles exported from the United States on the ..... day of ....., 19...., by ....., address ....., (actual shipper) for the account of ....., address .....; that they are returned to ....., address ....., for the account of ....., address .....; that the said articles were exported solely for temporary scientific or educational purposes and for no other use abroad than for exhibition, examination, or experimentation; that they are being returned without having been changed in condition in any manner, except by reason of their bona fide use as follows:

.....,
(describe change in condition)

that such articles as are of foreign origin have previously been duly imported into the United States; and that no duties or internal revenue taxes were remitted, refunded, or allowed by drawback on the exportation of any of the articles described in the entry.

.....
(Ultimate consignee)

Declared to under oath before me this ..... day of....., 19.....

.....
.....
(Title or designation)

THE STORY OF BIOMETRY

Being the Life of Karl Pearson*

KARL PEARSON IN HIS ROOM AT UNIVERSITY COLLEGE

Figure 17

Karl Pearson photographed in 1910 in his room at University College. This was the most fertile period of his life. He was then "head of the Department of Applied Mathematics, in charge of the Drawing Office for engineering students, giving evening classes in Astronomy, the director of two research laboratories and the editor of their various series of publications and of *Biometrika*." From *Karl Pearson*, Cambridge University Press, 1938.

MANY who overlooked this interesting biography in the journal *Biometrika* will doubtless read it with pleasure in book form. A biography of a man of science, written by another scientific person, particularly when the biographer happens to be the subject's son, might be expected to have a mixture of characteristics. The expectation is not one that could be arrived at by biometric methods, however, and the reviewer is not certain what he expected the narrative to be before he entered upon it. When it was finished, however, there was no doubt of its qualities. Its mean is high as befits the distinguished mathematician's accomplishments, with a low standard error deriving from his biographer's uniformly understanding treatment, and there is little skewness such as might have sprung from any partisanship of the author.

Karl Pearson's career developed largely out of his inherent characteristics. One of them, as he himself stated, was a capacity for roving into other people's preserves; and how often was he twitted, to put it mildly, for poaching on the bi-

*PEARSON, E. S. *Karl Pearson*. An appreciation of some aspects of his life and work. viii + 170 pp. Cambridge. The University Press. 1938.

ologist's domain—until the biologist came to recognize mathematical statistics as a necessary part of his own equipment. Another characteristic was a degree of combativeness. This was almost certainly correlated with his propensity for poaching, with an r at least as high as 0.90. Though reading character from facial expressions may be as dangerous as that from cranial contours, one can scarcely avoid concluding from Pearson's earlier portraits that here was a spirit that thrived upon challenge. As a college youth he carried a chip on his shoulder in the matter of compulsory attendance on divinity lectures—and the chip was not removed. It was still there when he commented upon the descriptions in the catalogue of the British Museum, and brought upon himself, editorially, the designation "that terrible person K. P." In later years it led to controversies, notably to that with William Bateson over Mendelism and biometry as approaches to knowledge of heredity and evolution. There are two parties to a controversy, however, and Bateson was presumably one of them in this instance, for his style was not one to mollify an antagonist. Pearson was depressed by these passages of arms, but could scarcely be regarded as repentent. They led to a degree of loneliness where a little forbearance on both sides could have created an atmosphere of friendly cooperation.

Pearson's interests were varied. He had an early leaning toward the law, delved now and then into German history, and wrote some verse. He collected portraits and hung them, with quotations serving as mottoes, upon his laboratory walls. In his declining years he longed for a farm where he could raise something—sheep, poppies, anything; but mathematics early made a leading claim upon his attention, and remained his chief concern to the end. His first appointment was to the chair of applied mathematics and mechanics at London; and the Gresham lectureship in geometry in 1891-1892 contributed to the same end. Though he applied more than once thereafter for vacant professorships, they were always positions that were definitely in, or could be brought into, the field of mathematics. Even when he became professor of eugenics, it was with the stipulation that the work of the biometric laboratory should not be diminished. Pearson had for some time applied statistical methods to questions of human heredity, or to heredity in general, and to evolution. There has been a difference of opinion as to his central concern in such studies. Biologists have often regarded them merely as his means of putting his statistical methods to work; but his biographer attributes them to a direct interest in the nature of these biological phenomena.

PEARSON AT 33 YEARS OF AGE

Figure 18

Photograph of Karl Pearson taken in 1890, the year he married Maria Sharpe. He was then at work on the first edition of *The Grammer of Science*, which was published two years later. From *Karl Pearson*.

The great personal influences in his life were those of Galton and Weldon, the former as a pioneer in the biometric field and eventually as a benefactor, the latter as both an inspiration and a disciple and provider of biological material for his studies. The death of both of

these men while Pearson was still in his prime constituted one of the first blights upon his laboratory. A second was visited upon it by the World War, which changed the interests of the intellectual world in so many ways, and trebled the costs of all such activities. But personnel was gradually restored, substitute financial aid arranged, and at Pearson's retirement in 1933 his laboratory was a going concern.

Older biologists who were not biometricians knew Pearson chiefly through his *Grammar of Science* which went into an unfinished third edition and several translations into other languages. The younger group not engaged primarily in statistical work have followed him mostly in the journal *Biometrika,* which he founded and edited. All who use any of the statistical tools are indebted to him for formulas and important tables. To these watchers from the side lines, this biography serves almost as a brief history of the development of biometric methods, which are being so ably advanced now by others. To some who make occasional use of formulas and tables without too great an understanding of the mathematics behind them, an interesting by-product of the biography is is revelation that "Student" had a real name. Pearson's philosophy of teaching was that a professor ought to give a new course each year, to insure his continued growth; but it would be quite clear from Pearson's six score publications, even in the absence of records to the contrary, that he never practiced this doctrine. To the end, he was deeply concerned that his department should maintain a research rather than a teaching laboratory.

The book ends with a list of Pearson's publications, outlines of many of his lectures, and his reports to the Company of Drapers which furnished financial support for his work for many years.

A. Franklin Shull
University of Michigan

◆

ZOOLOGY OF THE CHORDATES

THIS book* is a successor to "Vertebrate Zoology" by the same author, which for so many years has been an important text and reference in the teaching of comparative vertebrate anatomy. Like the older volume the organization is unique in that the subject matter is presented by animal groups rather than by organ systems as in most textbooks dealing with the same field. It is intended and well adapted for use in a course in which laboratory and lectures are essentially independent and where the laboratory may deal with a system by system study. In this connection special new chapters dealing with the anatomy of the dogfish and salamander as generalized vertebrate and tetrapod types respectively have been added. They are clearly written and suggestive without depriving the student of all of the pleasure of exploration and could be used in lieu of a laboratory manual if necessary. Likewise there is a brief section on mammalian anatomy.

Beginning with the discussion of the problems and methods of classification of the chordates, the author presents a specific system of classification and follows it with a chapter on the principles and factors of vertebrate evolution, drawing together the gist of modern thought upon vertebrate morphogenesis in a summary and stimulating fashion. The remainder of the book is concerned with discussions of each of the vertebrate groups in which group characteristics, embryonic development, fossil ancestry and natural history each receives due attention.

A chapter is devoted to each of two prochordate classes, the Cephalochordata and the Urochordata, and to the Hemichordata as a separate phylum, for which arrangement good reasons are presented. The most primitive vertebrates including the fossil Ostrachodermi and the living Cyclostomata are treated

*Newman, H. H., *The Phylum Chordata,* The Macmillan Company, 477 p. 1939.

together. Five chapters are devoted to fishes, including a general introductory chapter, and supplementary chapters on the shark like fishes, the dogfish, bony fishes and modern teleost fishes. Perhaps the weakest part of the book is that dealing with the Amphibia. This, being the transitional group between the land and water forms, may be regarded by some as deserving of a more extensive treatise. However, most if not all of the essential facts are available. In contrast the three chapters on the reptiles, although presenting a clear and concise treatment of both living and fossil forms, seems much more extensive. Birds particularly and also mammals seem to be quite adequately covered.

It is perhaps the more liberal treatment of fossil ancestry and natural history phases of the subject together with the conventional anatomical subject matter which makes this book outstanding not only as a textbook but also as a valuable reference for supplementary reading where other text material is used.

Particularly helpful to the student will be the summaries at the end of the discussion of each taxonomic group. Here the primitive, the specialized and the retrogressive characters peculiar to each are separately emphasized. The illustrations and index are excellent. There is no bibliography. In general the book is very skillfully prepared and quite usable.

P. B. SAWIN

Brown University

✦

GENETICS OF MAN

THIS work* may be regarded as a valuable contribution to the science of heredity and eugenics. In a concise and scientific manner, the author has produced a treatise which is sufficiently detailed to serve as a textbook in medical schools, as well as for the needs of the individual student, particularly in the modern German State. The emphasis on basic principles makes the book valuable as an intermediary between the scientist and the school; in addition, its usefulness as a guide to the intelligent lay reader should be emphasized.

The book is divided into two sections. Part one deals with the fundamental laws which govern heredity. Individual chapters are devoted to the cell and cell formation, the laws of inheritance (including a discussion of the Mendelian Laws), variability of characters, including multifactorial traits, phenotypic variation in pure line cultures and the like. The theories of Lamarck and the old and new schools of "Darwinism" are dealt with briefly.

Part two is concerned more especially with hereditary characters in man, racial science and eugenics. Twin studies and investigations in family groups form the basis for the study of racial inheritance on a larger scale. Statistics of ancestors based upon genealogical data are given. The occurrence of an inherited abnormality as dominant and the inheritance of sex are treated in the consideration of marriage. In the section dealing with human types, the author discusses the inheritance of bodily characteristics, the most important deformities or abnormalities; abnormalities of the sense organs, internal mal-adjustments such as high blood pressure, anaemia and diabetes, and nervous and mental diseases. Other topics are the inheritance of intellectual and temperamental attributes and tendencies, and the interaction with environmental influences.

In the section on racial science, the author discusses the origin of man, commencing with some important primitive types such as Neanderthal and Cro-magnon man. Later sections deal with the differences between these early types and modern man. The development of the idea of "race" and "nation" and study of the "race" as a science are characteristically German in their philosophical outlook. The soul and spirit of the race which, according to some anthropological investigators is of doubtful existence, forms the basis of much discussion. Final chapters deal with the rise and degeneration of races.

R. M. W.

GRAF, JACOB. "Vererbungslehre, Rassenkunde und Erbgesundheitspflege" 5ten Auflage, J. F. Lehmanns Verlag, Muenchen, 1938.

A COLCHICINE-INDUCED TETRAPLOID IN BUCKWHEAT

W. J. SANDO
Bureau of Plant Industry,
U. S. Department of Agriculture

THE most striking effect of the doubling of the chromosome number of a plant species by the use of colchicine, or by other treatments, has been an increase in the size of the pollen grains, tissue cells, seeds and certain other parts of the plant. An increase in the seed size of certain small-seeded species of plants may prove to be materially advantageous.

In the spring of 1938 the writer applied a thick paste of one per cent colchicine in lanolin to the stems of eight three-weeks-old seedlings of Tartary buckwheat (*Fagopyrum tataricum*). Six of the plants of this self-fertile species showed considerable swelling of the stem at the point of application of the colchicine and produced seeds considerably larger than those from the untreated plants. Examination of the pollen of the flowers produced by the colchicine treated plants showed the characteristic increase in size observed by others in similar investigations. Confirmation of the doubling phenomenon was made by root tip counts* of the chromosomes from germinated seeds of the treated plants. The normal somatic number of *Fagopyrum tataricum* is 16 while the plants resulting from the treatment with colchicine had 32.

In general, the tetraploid plants grown outdoors and in a greenhouse during the fall of 1938 were taller and flowered and matured their seed slightly later than the diploid plants. The main stems of the plants of the tetraploids were 33 per cent greater in diameter than those of the untreated plants. The leaves were more irregular on their margins and surfaces, thicker and deeper green in color,

NORMAL AND TETARPLOID BUCKWHEAT

Figure 19

Branch and seed of Tartary buckwheat (*Fagopyrum tataricum*) from normal diploid (2*n*) and colchicine-induced tetraploid (4*n*). The increase in chromosome number was accompanied by a general increase in size, which is frequently but by no means universally observed in polyploid forms.

*For preparation of the root tip slides the writer is indebted to M. M. Rhoades and Virginia H. Rhoades.

and were 60 per cent greater in diameter than those of the check or diploid plants. The pollen and open flowers were about 57 per cent greater in diameter than those of the untreated plants.

Although there was some variation in the number of seeds to the cluster in both tetraploid and diploid plants some clusters of the former were observed to have as many as 25 per cent more seeds than those of the untreated diploid plants. As may be observed in Figure 19 they are also considerably larger. The seeds from the tetraploid plants usually were not more than 35 per cent greater in length and the surface of the hull was rougher with more prominent lateral ridges than those from the diploids. Usually the endosperm and embryo in the tetraploid plants were not enveloped by the hull so closely at the pointed end of the seed as in the diploid plants but showed a considerable cavity between them and the hull. The weights of the seed, endosperm and embryo, and hull of the tetraploids were 41, 15, and 63 per cent greater, respectively, than those of the normal diploids. In the tetraploids observed the hull was 28 per cent of the total weight of the seed while in the diploids it was 21.5 per cent. This greater percentage of hull in the tetraploid seed is due to the failure of the endosperm and embryo to enlarge sufficiently to completely occupy the inside of the hull. Additional characters such as anthocyanin in the stems and leaves and hairs on the stems and petioles were more accentuated in the tetraploid plants than in the diploids. In these experiments doubling of the number of chromosomes of Tartary buckwheat increased the size of the various plant parts 15 to 63 per cent.

Jane Clapperton—A Eugenic Pioneer

The first of a "Social Science Series" of pamphlets edited by W. P. Dreaper is entitled "The Future of Civilization and Social Science" (London: E. T. Heron and Co., Ltd. 1*s*). In it Mr. Dreaper presents a study of the principles of scientific meliorism based on Jane Hume Clapperton's book published in 1885, in which socialism is defined as concerted aims for social ends, and scientific meliorism may be regarded as a form of socialism under which progress must come through the individual social unit and not by means of social veneer. Scientific meliorism discriminates between benevolence which is beneficial and that which is not, giving no support to charities which injure the independence of the poor, or relieve them of parental responsibility. It opposes the social forces of sympathetic selection which result in the survival of the unfit and seeks to promote intelligent selection which would result in the birth of the fit. It strenuously supports co-operation in industry as a means of progress and harmony of interests, and proper distribution as a means of improving human conditions. Scientific meliorism also advocates a rational treatment of crime, in which vindictiveness has no ultimate place, and calls for a similar rational attitude to such questions as manners, dress, the equality and relations of the sexes, marriage laws, laws of inheritance, etc., the regulation of population in relation to the natural and industrial position of a nation, and Mr. Dreaper briefly discusses the bearing of its principles on the study of international problems. — *Nature* (London), Mar. 26, 1938.

How to Construct "Family Trees"

THIS book* is a description of a number of different methods for preparing and presenting a pedigree. Although the author is chiefly concerned with genealogy and its specific problems, he emphasizes genetical viewpoints sufficiently to make his readers realize that conditions well known to eugenists and geneticists must be fulfilled before a pedigree can be of any value for genetical research. The booklet is pleasantly written and well illustrated.—C. B. S. H.

KAESSBACHER, MAX. Die genealogischen Methoden als Grundlage der menschlichen Erb-, Rasse — und Konstitutionsforschung. Muenchen, (Verlag der Aerztlichen Rundschau), 51 pages, 27 plates, 8°, Rm. 1.80. 1934.

FAMILY PLANNING AND CULTURAL CHANGE

LAWRENCE K. FRANK

THERE is a growing awareness that the family is undergoing extensive changes of which the limitation and spacing of children is perhaps the most dramatic. Efforts to control conception have been made for thousands of years, but technical developments and social changes today are making methods of control available to increasing numbers, who are adopting these practices as never before. What, then, is the cultural context today in which we should seek for the wider significance of contraception?

Let us recall, very briefly because they are so familiar, a few of the outstanding social situations of today. We are approaching a stationary population with a predominantly older age distribution, a situation that apparently has never existed before. The birth rate has been declining rapidly, but differentially, so that there are wide variations in the fertility of different groups. Sterility apparently is increasing, or at least we are discovering how frequently sterility occurs, especially among males. Many men are also suffering from impotence. Abortion is widespread and apparently increasing, although little reliable information is available. Injuries, handicaps and life-long impairments are not infrequently the accompaniment of child bearing, and breast feeding appears to be declining.

The Family Under Stress

Marriage and the family are under great stress and strain, as evidenced by marital conflict, divorce or separation, problem children, delinquency, and by many childless homes. Moreover, there is a significantly large number of men and women who are voluntary or involuntary celibates, while others are engaged in extra-marital unions, both temporary and more permanent, in prostitution, in male and female homosexuality and in sex offenses against children, (including incestuous fathers and uncles). With the progressive weakening of the older social regulations upon sex, there are apparently more sex antagonisms and emotional conflicts between men and women than before.

The home is in all stages of transition as the family progressively relinquishes its older functions and responsibilities to social agencies and industrial processes. The mother, following the earlier example of the father, is going out to work in a society in which economic security has become more precarious, as men and women struggle to *earn* a living instead of *making* a living. The emancipation of women has proceeded rapidly, freeing women from many older handicaps and limitations but bringing other responsibilities and many deprivations for which she has had little preparation. At the same time men are confronted with frustration and despair as they seek to fulfill the older masculine roles of economic competence and family maintenance.

These are all familiar to you and are repeated here merely to remind you of the social setting in which our discussion is framed. But these more overt, observable aspects of our social life today assume a new significance when viewed in the context of a changing culture, which is bringing us new ideas, conceptions and beliefs, as well as novel expectations. Again we can pause only briefly to review the more outstanding features of this cultural change, reminding ourselves how the traditional Western European conception of the nature of the universe has been undermined since the seventeenth century by astronomy and geology and how today this picture has

again been radically revised by mathematical physics and astrophysics. Also we must remind ourselves how the historic conception of man's place in the universe, as developed by theology, law, ethical and moral philosophy, has likewise been undermined by paleontology, biology and anthropology. Unless we do reflect upon these major shifts in our picture of the world and of man's place therein, we cannot realize what terrific assaults our culture has undergone during the past three hundred years, nor understand how the bases of our personal, emotional security have been lost.

But these changes, bitterly contested by our fathers and forefathers, who feared the ruin of their society when the older anthropocentric cosmology of Genesis was threatened, were only forerunners of the more profoundly disturbing alterations we are witnessing today in the current struggles over the conflicting conceptions of man's relation to his society. We are immersed in these conflicts, indeed we ourselves are creating and participating in these conflicts, as we dispute and war over fascism, communism, democracy, and the many, many specific questions of man's duties and privileges economically, politically and socially. These questions occupy the forefront of our current anxieties and programs and they will probably continue to be the focus of world-wide concern and strife, just as in the past we have had prolonged wars over conflicting religious ideas and conceptions. But another and perhaps more bitter conflict is arising over the more recent conceptions of human nature and conduct, as the older theological beliefs about human nature are challenged by new ideas and concepts, new insights and new aspirations toward human values.

You may at this point wonder at this seeming digression into a philosophical discussion that, however interesting, seems remote from our topic. But if you will see these basic conceptions as providing the fundamental dimensions of a culture, with which each individual builds his private world and by which he charts his life career, you will, I hope, realize that we must seek the larger significance of contraception within this context of a changing culture, because these basic ideas have molded our inherited conceptions of sex, marriage and parenthood. Moreover we can find the clue to the attitudes of individuals and groups toward contraception in these concepts and beliefs.

It is becoming clear from the findings of cultural anthropologists, that what we call sex can be, and is, patterned into a great variety of ways, as different cultures have prescribed the masculine and feminine, and the male and female rôles; have established socially sanctioned sexual relations; and have defined marriage, the family and the relationships of its members.

Changing Sex Traditions

We today have our own peculiar ideas about rôles, sex relations, marriage and the family. If we see these ideas and beliefs about sex in the historical perspective of Western European culture, as they were built into it and were supported by the conceptions described earlier, we will begin to realize that our whole tradition of sex is changing, along with the shifts in this conceptual background. With a newer conception of the universe and of man's evolution therein, with the challenging of the older notions of man's relation to his group and with the emergence of an altered conception of human nature and conduct, these older ideas and beliefs about sex must disappear along with the cultural context that alone gave them meaning and sanction. It must be recognized, however, that we are in all stages of change today as we cling to some old beliefs while rejecting others equally obsolete, so that we have little common basis of understanding or concerted action today.

Time will not allow for any extensive or detailed discussion of how these beliefs about sex are being modified. We should pause to note how the belief in a rigid dichotomy of male and female, of masculine and feminine, as innate, biologically determined differences, is yielding to a conception of bi-sexuality, in

structure, function, endocrines and personality, which calls for extensive revision in our thinking and conduct, especially more tolerance for individual differences. Again we may note the traditional beliefs that sex is obscene and shameful, the deplorable but inescapable animal part of man; that sex intercourse is a concession to the weak sensual failings of the male (in which the female was not and should not be interested); that intercourse is permissible only for procreation, when socially and religiously sanctioned, in accordance with the Pauline injunction of wifely submission to the husband. Today we see how these beliefs are being relinquished as we realize the impossibility of separating mind and body and the tragedies of emotional conflict which they engender. Moreover we are discovering that intercourse for procreation only is essentially the subhuman pattern, since only man and some of his fellow primates have been able to make of sex something more than just breeding. We are beginning to realize that these traditional beliefs are derived from, and find their justification in, the older anthropocentric cosmology, the older notion of man as a unique creature with no evolutionary history, the older belief that the individual should be sacrificed for the State and the ancient conception of man as essentially wicked and sinful, whose feelings and emotions should be rigidly repressed.

In this area of concern over sex, we are beginning to discover that the ideas, values and teachings of an individual are largely colored by his or her personality, life history background and individual pattern of sex expression or repression; also we are discovering that sex teachings reflect not only the personality but the professional bias of the minister, physician, psychiatrist, urologist, obstetrician or writer on this topic as well as the climate of opinion in which he lives. It is becoming evident then that our sex ethics and teachings have been warped and distorted by those who have projected their own obsessions and conflicts and professional preoccupations upon our culture.

Moreover, it is being realized that our sex ethics and morals have an almost exclusively masculine origin and that the men who have been preoccupied with sex ethics and moral teaching have been, largely, those who have been engaged in a life-long struggle over sex; we are beginning to recognize this as essentially a neurotic, if not psychotic, conflict, that necessitates a passionate conviction of the sinfulness of sex and the degradation of women, with an almost sadistic pleasure in condemning her to the rôle of passive sex object and breeding animal.

As we glance back over the history of human rights and values, and this extraordinary tradition of the degradation of sex, we see an age-long struggle over the emergence of woman as a personality, who only slowly and very recently has begun to achieve emancipation from sexual exploitation, (as in the feudal *jus primae noctis* still being exercised by some employers of women), and who are still striving for free choice in marriage. The inviolability of her own person is still to be clarified by and for woman, as we see in the present social conflict over divorce and separation and the doctrine of wifely submission.

A New Right Emerges

Today we are witnessing the emergence of a new human right, the control over her own fertility, for which women are seeking social recognition. This, I believe, to be one of the great events in the development of human rights, fraught with immense significance for woman and for her children, for the family and for our whole social life because it at once provides the opportunity and also presents the necessity for projecting new ideas and values in marriage.

Thus we are faced today with a task of transcendent importance to develop a new and better sex ethics, in which contraception will play a large and critical rôle. It is necessary to emphasize here that without new sex ethics and aspirations, contraception may prove disastrous, for we cannot be blind to the possibility that birth control may be used to foster sexual irresponsibility and per-

sonality distintegration even worse than we have today, again forcing women back into the rôle of sex object to be used by the irresponsible male. Some years ago a young girl character in a novel by Aldous Huxley, remarked, "Of course, contraception has made chastity unnecessary," a remark that implies the whole tragic confusion and distortion in our thinking about sex.

It is noteworthy that so many movements for sex reform have sought what is called "sex freedom" in tragic ignorance that neither man nor woman in our culture can tolerate "sex freedom," as most experienced psychiatrists and psychoanalysts will testify. Both men and women need that which will make sex meaningful and fulfilling, since as products of Western European culture we cannot function on a purely physiological or genital level, because we are personalities who seek values and fulfillment of emotional needs and aspirations in sexual relations. It is these aspirations that are leading increasing numbers to reject the degraded sex ethics and sub-human conception of marriage of our theological tradition.

Here we should reflect upon the need for distinguishing between the physiological or genital and sexual, meaning by sexual the participation and expression of the whole personality. But sexuality has to be achieved and many, under our existing moral teachings and unhappy family situations, never get beyond merely genital or gonadal interests and activities. Indeed many men and women grow up denying their sex, as we see in most prostitutes, or suffering from psychological impotence, as we see in many of her male customers. Indeed it is not unwarranted to say that mature, adult sexuality is not very frequent. We cannot offer contraception then, to a society with these inner conflicts, frustrations, distortions and fixations upon purely genital interests, without attempting to create a more decently human sex ethics. I believe young people today are desperately seeking for such a new sex ethics because they have discovered how meaningless and devastating is "sex freedom" and merely genital activity; they are searching for values and a design for living worth striving for, to give their lives tension and purpose and fulfillment.

It is, then, in the context of a new sex ethics, that we can see contraception gaining its larger significance. It is true that for a long time, it will be a much needed defense for women against unwanted pregnancies to which they are exposed when used as sex objects. But can we not also look forward to the more constructive goal of reconciling our personality and genital needs in sexual relations that bring fulfillment of the deeper desires and aspirations of both men *and* women? It is not sentimental nor irrelevant to say that the idea of love, in and through which we may seek to reconcile and to attain our personality fulfillment, is probably one of the major ethical ideas of Western European culture, an idea that if not cherished in the lives of individuals, may be destroyed in the stormy days to come.

The idea of love in sex is important because it can make sex altruistic instead of exploitive and help us to use the marvelous genital and erogenous functions in sex, as another language, a means of communication between one lonely human being and another. We have in recent years become aware of the tragic irony of "starvation in the midst of plenty" of food and goods. But there is an even more tragic irony in the widespread emotional and sexual starvation in the midst of plenty, as men and women hunger for intimacy, affection and sex fulfillment, but cannot, because of distorted ideas and beliefs and fear of unwanted pregnancy, find each other, even in marriage.

Again we may see contraception in a more constructive context if we can think of planned pregnancy as an affirmation, to be made deliberately and jointly by a man and woman, who see in child-bearing a way of affirming their personal and social values, signifying the importance of love and courageously projecting those beliefs into the future. Such affirmations can be made, and will be made, only by sane, mature men and women who see

some possibility of realizing a decent society. Such affirmations, I believe, may be desperately needed by women today, as they face the current scene in which their biological creativity is being limited, if not denied, while they are called upon to justify themselves by achievement. We have learned to recognize how devastating may be the male's anxiety over his potency; but is it not possible that denial of fertility may be even more destructive to the woman? One cannot help wondering how much anti-social behavior arises from these feelings about sex that have to be expressed in aggressive, destructive conduct.

In our concern with the man and woman, we must not ignore the significance of contraception for children. From clinical studies of problem and delinquent children, we are learning how the child's personality is distorted by cruelty and harsh treatment, especially by the father and by the overt rejection or the over solicitude of the mother who is trying to hide her rejection of her child. Already there is much evidence to show that the unwanted, unloved child often becomes the socially destructive, noncooperative, obstructive, or aggressive adult who makes it impossible to build a decent social life.* Perhaps tomorrow we will discover that a "hostile uterus" is not a mere figure of speech, but a definite, measurable physiological condition and that many difficulties of pregnancy and of labor are intimately associated with the emotional attitude of the mother toward her marriage and her pregnancy.

Birth control has been established by the devotion and self sacrifice of a group of pioneering lay men and women, largely women, who against incredible obstacles and opposition have made contraception socially possible today. Their vision and courage are even more necessary today and tomorrow, if we are to carry forward and attempt to attain the human goals that contraception now makes possible and to maintain this new human right of control over fertility. As we look forward to a declining birth rate and a stationary, if not declining, population, we must recognize the possibility that contraception may again be outlawed when the full extent of the falling birth rate is realized and panicky action is taken. We can see this in several countries abroad, where the State is attempting to coerce women into the rôle of passive breeders of children primarily for military purposes.

There is an urgent need therefore to create a positive and socially significant program for the control of fertility, that will attempt to reduce fertility in those areas and groups and families where excessive, while actively fostering fertility among others; that will promote contraception as an instrument of preventive medicine and maternal health but recognize the need of many women for pregnancy and lactation for biological and personality fulfillment; that will discourage child-bearing by those who cannot or will not provide parental love and emotional security for the child; and that will foster, in every way possible, new family patterns and ideals, new rôles for men and women, especially for the male who needs help to achieve the psychological potency and emotional integration necessary to a stable, continuing marriage and the fulfillment of the woman's immense sexual needs.

If we had time to follow the ramifications of this theme, we would see how it leads into many questions of social and professional import. How we treat the "pregnant family," for example, offers a large opportunity for constructive help. Are we failing to recognize the personality and emotional needs of the pregnant family, especially of the woman who may be more desperately in need of reassurance, understanding and insights than of the urinanalysis, blood pressure readings, diet and exercise of our standardized prenatal care? Again are we aware of the significance of the hospital experience to a pregnant woman, where so often the professional preoccupation with purely biological processes of parturition has

*"The Fundamental Needs of the Child," *Mental Hygiene* XXII, pp. 353-379. July, 1938.

largely obscured the human event and its meaning to the woman herself, who may bitterly resent being treated as a breeding animal? We might, if courageous, even wish to examine what is being done, often unconsciously, to prevent breast feeding, in disregard of the need many women have for lactation as a part of their biological and emotional maturation, and ignoring the influence of breast feeding upon the future personality of the child. Should medical thinking and practice be limited to the purely genital and reproductive concepts, to the neglect of the personal, the human, the emotional? In this context perhaps the conception of woman held by the physician may be as important as his professional knowledge and skill. Questions such as these we must ask, if we are genuinely concerned with the control and encouragement of fertility among women of intelligence and sensitivity. These are questions that women themselves should be encouraged to raise, together with many other questions about the validity and desirability of this man-made and man-controlled world. I can not, myself, believe that feminism should be limited to economic emancipation of women and freedom to engage in competitive striving, when so many of the fundamental needs and values of women are being ignored, frustrated or destroyed. Cannot women help to rescue us from the prevalent frustration and futility of our contemporary social, political and economic life in which they and their children are the worst sufferers? There is an urgent need for women, as women, to assert their aspirations and needs in the formulation of educational programs, of housing, social planning and other social actions, on behalf of the family and children.

All these considerations have, I believe, equal significance to both the eugenics and birth control movements. The two movements appear complementary and each is more or less incomplete without the other because they have a common focus in the family and are directed to the same goals. Moreover both are dependent upon the development of a saner, more human sex ethics and a wiser and more enlightened education for marriage and family life to help young men and women meet the current social and cultural confusions with courage and with the knowledge that will enable them to avoid the conflicts, frustrations and defeats they see so frequently in marriage today, and with faith in the possibility of achieving human values. For such an education both birth control and eugenics are necessary, but both must go beyond the genitals and procreation and recognize the individual personality and its need for values and envisage the total family situation and the needs of all its members through family consultation and guidance. This means that contraception cannot wisely be divorced from a philosophy of individual and social life and family guidance, nor can eugenics become a directive social movement until the control of fertility, in the wider sense of planned childbearing, has been recognized as one of the major steps toward the creation of a new and more humanly desirable culture that will foster normal, wholesome, sexually and socially well adjusted men and women who *will* have planned—for children. Perhaps we should begin to think of contraception as a two-edged sword to be used wisely, humanly, lovingly, *and* eugenically.

If for this reorientation and the immense tasks it reveals we can count upon a portion of the energy, devotion and self-sacrifice that have brought the birth control movement to its present position, I am sure we can look forward with hope and confidence.

GIVING PUBLICITY TO EUGENICS

ALBERT EDWARD WIGGAM

THOSE of us who have been engaged in this Eugenic Movement for many years are coming more and more to realize that every word we say to the public, or even among ourselves, should be subjected to the most critical examination. Perhaps some of us can be forgiven for ill considered and over-enthusiastic statements made in the past, because it has only been in recent years that we had an organized group of competent students to whom we could submit our ideas and opinions. For prior to the past six or eight years, any one in this country or Europe who spoke or wrote on eugenics was very much in the situation of the drunken Englishman who jumped through a plate glass window "because it seemed to be a good idea at the time." With a courage born of an ignorance of social forces, population trends and the psychological variables associated with reproducti n that was well nigh exhaustive, we advocated almost any idea that seemed to us to be a good one at the time.

May I say, however, that the most hopeful thing about this Eugenic Movement, as I see it, is the entire harmony in thought and action and the critical, although generous, examination of each other's ideas that now animates the members of our Society. For if there be anything in the theory of mutual aid as a factor in evolution, we are trying to put it to the test in the evolution of both a theoretical philosophy and practical program for making eugenics not only our own common objective, but also the spiritual ideal and the structural and dynamic objective of society itself. For eugenics will never succeed unless it can be woven into the very design of living which gives the fullest satisfaction to these inner drives and organic trends that are the outcome of man's own evolution.

This does not mean that we are a mutual admiration society. Far from it. Every suggestion that is advanced is subjected to the most critical and merciless analysis; and wherever possible the criticism of the most competent representatives of the numerous social and scientific disciplines is earnestly sought. But, I believe that every member of our group feels, with that "morality touched with emotion," which Mathew Arnold maintained was religion, that the objectives we have in view are the loftiest and most inclusive that have ever stirred the creative imaginations of men; and for that very reason personal pride and sensitiveness is completely submerged in the *esprit de corps.* For we believe we would be poor representatives of eugenics if we did not achieve that submergence of self for the strength and success of the group which we conceive to be the very essence of the eugenic life. For eugenics means *a new kind of life* that men have never yet lived. A few men have lived it but the masses have not. Perhaps the ancestor worship of the Orientals, if it had a scientific basis, would come the nearest to this design of living. Eugenics is really ancestor-worship "looking backwards"—toward our descendants.

Eugenics a New Kind of Life

I mention this phase of our thinking both to those who have already written in the field of eugenics and those who have not, merely to call attention to the extraordinary difficulties and the truly immortal responsibilities of our task. For eugenics means the organization of every impulse and drive of men towards the creation of a type of culture that will, by its own agencies of living, create men and women who are better than we are —men who will respond more readily to education but will have less need for education, who will create better medicines but have less need for medicine,

who will create better forms of art and entertainment but who will have less need for the elaborate, gadget-produced entertainment of our day — men and women who by the dignity, poise and simplicity of their family and social life will find that fulfillment of function — that "sweet fulfillment of the flesh," and sweeter fulfillment of the spirit — which psychologists believe is the final answer to the problem of happiness. In short eugenics means the organization of all men's experience and all his science into a true, dynamic science of man.

True, this presents an impossible ideal —but all ideals present the impossible. "Ideals," as Carl Schurz said, "are like the stars; we shall never succeed in touching them with our hands, but, like the mariner on the desert of waters, we take them as our guides, and following them, we reach our destiny."

Writing "of Somewhat Else"

However, this does not mean we do not use every practical measure for reaching our ideal. We believe one of the most practical ways of at least starting humanity on the road toward the ideal of eugenics is to enlist the service of not only science writers, but dramatists, poets, and fiction writers as well. It would be both impertinent on my part, as well as carrying coals to Newcastle for me to suggest how each person can best perform his task. But, since I have written a great deal on this subject — very often to my later chagrin and regret —perhaps I may appropriately say that in my belief the most effective way to write about eugenics is not to write about eugenics at all. Francis Bacon said that when men come together for an important conference, it is their custom, "to talk for a time of somewhat else." No doubt many conferences are entirely consumed by talking of somewhat else. My view that the best method of writing and talking about eugenics by apparently, at least, writing and talking about somewhat else is well illustrated by Genevieve Parkhurst's admirable article in a recent *Harpers*, "Should Marriage Be Subsidized?", and also by the article in *Good Housekeeping* by Professor Huntington, "Ought I To Marry?" Very little is said in either of these articles directly about eugenics; yet both are admirable pleas for eugenics. I can think of few acts or customs of men or circumstances of their economics or politics or education or industry or of their climate or natural resources that does not have its eugenical significance. Eugenics is not the only thing in the world to write about; yet it is difficult to think of anything one could write about that did not have a eugenical bearing. Everything from freight rates to twin beds, from tariffs to cosmetics, from taxes on a professor's salary to the cost of obstetrics, from two-piece bathing suits to the methods of courtship has its effect on the organic destiny of man. This article is to point out that some writers may not have thought of these facts, and how they might in some way bring this eugenical significance either consciously or unconsciously into the consciousness—at least the subconsciousness—of their readers. Take such an example as the automobile. It has certainly enormously enlarged the area and multiplied the opportunities for love making. For the area of man's courtship has always been limited by the distance he could travel after early supper, spend as much time as possible with his lady love, and return, unobserved before daylight. Primitive man had to walk. Then came the ox cart which did not increase the distance, but gave the added thrill of a joy ride. Then came the saddle-horse, next the horse and buggy, then the automobile, and now it is the airplane. Indeed, with radio and television added, it may be that in time the humblest man's range of courtship will include the entire feminine population of the globe!

This is not a mere humorous fancy. Mrs. Wiggam and I recently made a study of one hundred marriages made in our little Indiana town of three thousand people during the horse and buggy days, and compared them with one hundred marriages made since 1910, after the automobile became a eugenical factor. Eighty-two per cent of the horse and buggy marriages so to speak were unions of two persons living within the city,

whereas sixty-five per cent of the automobile era marriages were between a person living within the city, and one from some other vicinity — often from some other state, or even some foreign country.

I cite this partly as an example of the far-reaching effects of man's methods and habits of life upon the inborn character of coming generations, and partly to call attention to those writers who have devoted their attention entirely to other fields, to this great fund of material for essay, lecture, fiction, drama and even poetry, which has buried in it somewhere a eugenical significance. This eugenical significance can be brought out without any loss of artistry by writers and speakers who have in some degree familiarized themselves with the history, background, methods, hopes and ideals of eugenics. This is especially true of the fields of social psychology and social biology and what might be termed generally the living sciences. Of course the larger portion of any science must, of necessity, be written in an esoteric language, known only to the members of the inner temple for in dealing in detail with specialized knowledge the conceptual shorthand of a technical vocabulary is necessary as a time-saver. It is not unscientific, however, as some scientists seem to believe, for even a scientist to make his meaning clear. It would not detract from the sum of either pure or applied science if scientists should take heed of a motto which no scientific journalist ever violates without a conviction of sin — a motto which I have pasted on my desk and which reads: "A great man is a man who is willing to use a little word when he knows a big one that means the same thing."

Reason and Emotion

These facts become important when we write with a view of promoting eugenics, because eugenics, to become effective, must draw upon every resource of science and at the same time appeal to the emotions and attitudes of men. Even the dramatist and fictionist who would give to his story a eugenical setting can best do it with the aid of the knowledge that science has placed at his disposal. The bare facts of science are wonderfully explained — usually by writers of genuine imagination in our encyclopedias, and in many books of scientific exposition. But to make science — whether it be economics or psychology or physics or chemistry or biology or sociology — an effective ally of eugenics, the aim of the writer must be, not to explain the wonders of science or to write a semi-technical exposition that will appeal only to educated persons. He must for the moment have the spirit, not of the propagandist, as that word is now commonly undestood, but of the educator burning with the passion to touch people's lives with new values, inspire them to new ardors and guide them to worthier personal achievements.

The writer therefore who can best serve eugenics is one whose aim is to write a nourishing story of some phase of nature that will make scientific truth a living, spiritual possession of the world. His aim must be to teach men how to use the instruments and discoveries of science in such a way as to win to friendly intercourse with his own life the universe in which he lives. Science alone will never lead men to any higher wisdom of life. For science has only revealed to man a universe that works; it is the business of the writer to build out of the facts of science a universe that has significance. I conceive that we who assume to write and speak with the hope of promoting eugenics can succeed only to the extent that we can crystalize and dramatize out of common human life on the one hand, and out of the discoveries of science on the other, new and higher values for which men shall desire to live.

Toward a Better World

The first desire of men inspired to create better values of life out of science is to secure these values for themselves. Therefore, it may come as a surprise to some who have thought of eugenics as a hard-boiled biological program, based solely upon heredity, to learn that the first objective of eugenics

is to build a better world. I can see no object in having an improved race if that race is to live in the jungle, either the jungle of raw nature or the jungle of "Tobacco Road" or the jungle of the slums of our cities. Biologists long ago discovered that it is only by improving the environment in such a way that it will of itself select a better and better heredity for survival that any race of plants or animals can be genetically improved. The crude method of nature has been to set up an environment so brutal that it killed off the unadapted, which usually meant the weaklings. Eugenics, however, aims to replace the bloody gantlet of evolution through death selection by a culture of ever richer and richer values that shall substitute the beneficent agency of birth selection in its stead. There is not a single object or circumstance or activity or habit of man about which writers can write, or philosophers think, or educators teach, or scientists explore, or playrights dramatize, or poets dream that does not lend itself to this great task.

I am fully aware that my brief presentation has been purely evangelistic, emotional and hortatory. But if science is to give new meanings to life, give men in the place of the old universe of fear and superstition a friendly universe of higher values and richer meanings it must train men's attitudes and emotions so they will use their utmost intelligence to organize these values and meanings into their life and culture. If we can do this, eugenics, instead of being some kind of separate program, such as Communism, Fascism or the New or Old Deal, will become the informing dynamic of society itself. It will bring a new, because a scientific, tolerance into the world, a tolerance that cuts across all class and racial lines, because its sole aim is to discover and develop to its highest in every class and condition of society every phase and form of human worth.

Men heretofore have become civilized because they wanted wealth, comfort, ease, luxury and personal importance; and eugenics instead of running counter to this ideal seeks merely to give it a higher fulfillment — so to organize all these agencies of the environment and these conquests of science and culture, that men shall be born with greater capacities for happiness, health and achievement than are possible to us. We thus set ourselves to utilize all the toil and blood and culture of the past in such a way that men shall put tolerance and personal development in the place of hatred and prejudice and war, so that in the end we shall have a naturally healthy, happy race dwelling in a healthy, happy world. The problem of the interpreters, the writers, artists, and dramatists is to work in conjunction with the scientists to bring this about.

Huntington's Chorea in Illinois

While completing an exhaustive study of Huntington's chorea from the genealogic, sociologic, clinical, pathologic and laboratory standpoints, Falstein and Stone found that in Illinois the choreic state hospital population remains more or less constant from year to year. Equal numbers of male and female choreic persons with a positive family history have been admitted to the Elgin State Hospital; for the state of Illinois as a whole there have been more female than male admissions, though the difference is not great. The age incidence so far as onset of symptoms is concerned includes every decade up to the ninth, except the first, with the largest number of cases in the fifth. Anticipation is not a constant characteristic of the disease; on the contrary, it appears to be the exception to the rule and is to be expected usually when neuropathic stocks are interbred. Because of the relatively late onset of the disease, many of the patients are married and the eugenic problem is made more difficult as a result. The nationalities represented by the Elgin and other Illinois state hospital cases include German, English, Scotch, Irish, Slavonic, Scandinavian, Lithuanian, Italian, Jewish and Negro groups, with many mixtures as well. There is a surprising number of Germans. About four times as many patients are admitted from urban districts as from rural. Regular choreic centers have been noted in various counties in the state. Although contributing only from 0.1 to 0.2 per cent of the general state hospital population in Illinois, Huntington's chorea presents a chronic problem from the social and psychiatric points of view, offering no practical prospects of solution at this time.—*J. A. M. A.* 112:2209. 1939.

THE EUGENIC VALUE OF A MATERNAL HEALTH CENTER

GLADYS GAYLORD

THE Maternal Health Association of Cleveland was intended to be a practical demonstration in eugenics since the purpose of the organization as stated in the Constitution adopted in 1928 states that: "The Association will support physicians in medical service and advice to married women to the end that children shall be begotten only under the conditions that make possible a heritage of mental and physical health." Though less concisely stated in 1928, it was clearly understood by those who supported this new organization that part of its function was to interpret to the community its program for the constructive use of child spacing in improving the human race. The Association was not to be self-perpetuating but was to exist as a demonstration in the community of the needs to be met until such time as its functions could be absorbed by existing social and health agencies of Cleveland.

There are two ways of presenting progress which has been made during the eleven years of this Cleveland demonstration in practical eugenics. First, through an analysis of individual situations which have been treated at the Clinic and through an analysis of statistics assembled during this period; second, through an evaluation of re-directed social attitudes in regard to an improvement in the quality of the human race. The second is the more fundamental contribution to a national eugenics program and is the more difficult to analyze.

Clients from Low-Income Group

A quick review of statistics in regard to the 9,535 families who have used the Clinic service during the last eleven years shows that the majority have come from the low income group of Cleveland, have had definite health reasons for seeking to space their children and have had grammar school education or less. It is understandable therefore that the majority have come with a desire to curb pregnancies. With each successive year of Clinic service it is noticeable that more families come in the early years of married life, accepting the service as a teaching agency for child spacing so that we find an increasing number of planned pregnancies recorded each year. There were 89 known, planned pregnancies recorded between March 31, 1938, and April 1, 1939. A steady increase in the number of those who come to the Clinic for pre-marital advice has helped to increase this number of planned pregnancies. This pre-marital group has also affected the table of patients' ages. There are now more people in the early twenties and fewer in the middle thirties among our new patients. This is an asset to a service which is primarily educational and makes it possible to stress the constructive side of the work.

Birth control services are often challenged on the basis that because methods depend upon the initiative of the patient they are not effective with people of low mentality. It seems to me that we are not yet fully aware of the psychological reactions in regard to pregnancy and that effectiveness of methods advised depends primarily upon the desire of the individuals to space pregnancies and not upon the quality of their intelligence. The following situation illustrates this.

In March, 1928, an 18-year-old Lithuanian girl came to the Clinic. Her baby was three months old and she had been married less than a year. Her history showed that she was the youngest of five children. Her mother died when she was four years old. Her step mother was cruel, so all the children were taken from their home by the juvenile court when this girl was ten years old. Her father was known to be a thief, and there was a possibility that he had assaulted her. Her experience in foster homes was not happy; she stole and lied, was unmanagable and unclean in her habits. Finally she ran away, and when again heard of by the

agency, was married, at the age of 17, to a man who was 35. He had never had a normal home life, was called a tramp, and reported to be irresponsible and unreliable. Her baby was born nine months later. During her experience in foster homes her intelligence quotient on several examinations was reported from 77 to 84 and application to the school for feeble-minded had been made. The prognosis for this marriage and its progeny was not good, but this is what has happened after contact with the Maternal Health service.

For 8½ years she has followed instructions, coming regularly to the Clinic for supplies and for annual examinations. We have reason to believe that she has followed these instructions carefully. During this time she has been a normal member of society, and has kept her home in fair condition. She and her husband have not wanted another pregnancy.

Among patients at the Clinic have been women and men released from hospitals for the psychopathic and insane, who have consistently followed instructions over long periods of time, usually with the help of the more normal partner in the marriage.

Planned Parenthood the Ideal

There is an eugenic value in curbing the reproduction of the unfit but it should be clearly understood by all members of a maternal health organization, by patients, by physicians and by lay people at large, that advice in controlling pregnancy should be given only when it is the desire of both partners in the marriage and that individual viewpoints of the patients should be respected to the *n*th degree.

The purpose of a maternal health association is also to encourage those people of sound physical and mental inheritance to plan their children at reasonable intervals and in increasing numbers with due regard to their own preferences in this respect. Continual contact with such families for over a decade has shown that young married people who speak of wanting six children at the time of entering the Clinic service, actually do have four pregnancies and continue to talk in terms of six. Many families enrolled in our research division have talked of themselves in relation to desired pregnancies as being "heir-conditioned." There are also those families with a low economic income who have had little or no sex education and who enter marriage with fears centering around the possible economic burden that a large family would bring.

One such young couple came to us in 1936. They had been married a little over a year and were in their middle twenties. He had a white-collar job on a small salary. She had been a teacher before she was married and they were both unable to face the possibility of a coming child, talking in terms of abortion since they knew of no other way out. It soon became evident that not only were they concerned with the economic burden but had had such a poor education for marriage that a good deal of instruction by a physician was necessary before they could face arrangements for the coming child. Fears in regard to pregnancy had to be allayed and arrangements for obstetrical care worked out before the advent of this child was accepted with understanding and joy. Following the birth of the child they enrolled as patients at the clinic in order to get the value of the child spacing service and are now talking in terms of their second child with a good family adjustment.

So much for the analysis of Clinic statistics and human data.

What effect has the Maternal Health Association of Cleveland had in re-directing social attitudes? For eleven years we have persistently promoted a program for better children in Cleveland. Always the approach was made with respect to other viewpoints, always with an effort to make our service fit in with other social and health programs as part of a community vision that was greater and more rounded than we could hope to be. Representatives of the Association have taken part in meetings of lawyers, doctors, teachers and clergymen; have met with college, settlement and church clubs; have presented the program to classes in sociology, to Parent-Teacher Associations and to labor unions. The Association now has a lending library for students, patients and physicians. No agency has been asked to endorse the Maternal Health Association but a practical working basis has been established with almost every agency in Cleveland. How can we judge the result?

Public acceptance is a feeling, a state of mind. We have it in Cleveland. The Maternal Health Association is generally accepted as a health agency of Cleveland—it is listed as a health agency in

directories and is spoken of whenever health agencies are mentioned. Members of the staff are included in conferences and meetings of health and social groups of the community. The Association is an associate member of the Health Council of the Welfare Federation of Cleveland and an associate member of the Ohio Welfare Conference. The community attitude toward the Association is one of acceptance and confidence and growing understanding of what can be accomplished through the service.

Part of a Community Program

This evidence of public acceptance is a recognition of the fact that the Maternal Health Association has always interpreted its work in relation to the social and health programs of the community in which members of the Association are themselves actively participating. In this respect we are only a part of a good community program in child health; in family conservation, especially when it attempts to stem the tide of increasing divorces; and in an industrial program, for it is evident that laborers are more efficient who have a well-balanced home life behind them.

Social attitudes cannot be re-directed unless there is public confidence in whatever program is being demonstrated. Unless a maternal health service in its largest interpretation can demonstrate that through a wise use of its service family life may be built up and enriched, then it will not be able to re-direct these attitudes. On the other hand if this is a constructive demonstration the spacing of pregnancies will become an accepted factor in preventive medicine.

When the words "birth control" take on a positive as well as a negative meaning, we shall be further on the right road; but with greater understanding of this new tool it should be turned over to the medical profession and should continue not as a separate service but as part of many different medical services.

A day will come when maternal health services will no longer need to be demonstrations of eugenic and race betterment programs because the function of this interpretation will have passed to educators, physicians, social workers, nurses and others as part of their accepted responsibilities. Until medical and other professions assume these responsibilities a maternal health service should feel it necessary to maintain the highest professional standards by means of a staff who are not only highly skilled in their own professions but are well-balanced and dependable personalities and should conduct its organization as a demonstration and training center in its own locality stressing the positive as well as the negative side of the service and carrying out sound research in both medical and psychological fields while continuing wise interpretation of the fundamental ideals to the public at large.

◆

The Problem of Mental Defect in New York State

Fourteen per cent of the residents of New York State—or nearly 2,000,000 persons—are below average or border-line in intelligence, Dr. Edward J. Humphreys, of Letchworth Village, told members of the Women's City Club, New York City, at a recent meeting on "The Challenge of Mental Deficiency." In addition to these, there are approximately 200,000 definitely classed as feebleminded. The state has facilities for only 16,000 of such mental patients, Dr. Humphreys stated, and pressure for admissions is constantly rising.

The problem cannot be borne entirely by state departments, but must be shared by communities as well, Dr. Humphreys declared. He said it was dangerous both in a political and a social sense to expect the government of a country or a state to be an all-provider, and that it is fully as important for the state to know its social assets and liabilities as its economic ones.

Miss Marian McBee, Executive Secretary of the New York City Committee on Mental Hygiene of the State Charities Aid Association, who also spoke, stated that there are in New York City at least 20,000 school children of defective intelligence. The special classes provided for children of that type can accommodate only 11,000; hence the facilities are scarcely more than 50 per cent adequate.—*Mental Hygiene.*

THE WAY TO MARITAL HAPPINESS

As Diagrammed by Lewis Terman—A Review

LEWIS M. TERMAN. *Psychological Factors in Marital Happiness.* McGraw-Hill, 474 pp.

MILESTONES in scientific work are few and far between but it seems probable that all investigations of the problem of happiness in marriage will, in the future, be dated either "before Terman" or "after Terman."

For the first time a really scientific effort has been made to evaluate the factors which operate to make marriage happy or unhappy. The results are presented in *Psychological Factors in Marital Happiness.* The research was carried out with the cooperation of 792 married couples and is so broad in scope as to make all previous work done in this field seem puny and insignificant. Not the least significant of Terman's results is the restraining influence it will exert on psychiatrists, psychoanalysts and "love experts" who, in the past, have felt free to spin yarns about the primary causes of marital unhappiness without fear of successful contradiction.

The first problem faced in the research was the development of an empirical test for distinguishing between those who are happily married and those who are not. This test was developed in a preliminary experiment in which three groups of subjects were employed, one consisting of 126 married couples reporting themselves very happy, another of 215 couples reporting themselves least happily married and a third group of 109 couples who were divorced. From the results obtained on these three groups, Terman constructed a test consisting of seventy items which yield reliable differences in marital happiness.

"For example, it is especially characteristic of unhappy subjects to be touchy or grouchy; to lose their tempers easily; to fight to get their own way; to be critical of others; to be careless of others' feelings; to chafe under discipline or to rebel against orders; to show any dislike that they may happen to feel; to be easily affected by praise or blame; to lack self-confidence; to be dominating in their relations with the opposite sex; to be little interested in old people, children, teaching, charity, or uplift activities; to be unconventional in their attitudes toward religion, drinking, and sexual ethics; to be bothered by useless thoughts; to be often in a state of excitement; and to alternate between happiness and sadness without apparent cause."

Terman and his assistants were then in a position to test the happiness of married couples and correlate their happiness scores with each of the answers obtained on a long list of questions dealing with personality characteristics, interests (taken from Strong Inventory of Vocational Interests), opinions about ideal marriage, childhood experience and attitudes, and numerous aspects of sexual life.

The results show that many factors in the background of marriage which have commonly been held to be of great importance have no bearing on marital happiness. These include "family income, occupation, presence or absence of children, amount of religious training, birth order, number of opposite-sex siblings, adolescent popularity, and spouse differences in age and schooling." Factors which have very slight relation to marital happiness are "age at marriage, years of schooling, sex instruction, age of learning the origin of babies, number of siblings, circumstances of first meeting between the spouses, length of premarital acquaintance, length of engagement, amount of adolescent 'petting,' and wife's experience of sex shock or her age at first menstruation."

The background factors in childhood and youth which contribute most to happiness in later marriages are: happiness of parents, childhood happiness, or a strong attachment for either parent. Re-

buffs for youthful sexual curiosity, lax or harsh discipline and conflict with parents contribute to later marital unhappiness.

Charting the Way

Terman's findings on the relation of sex to marital happiness show clearly that, as one psychologist has remarked "sex, like spinach, is highly over-rated" in marriage. Some sex factors do contribute somewhat to marital happiness, but even in these cases the correlation is low. Most of the factors emphasized by "sexologists" prove to be of no significance.

The ten most serious menaces to husbands' happiness are, in the order of their importance: a wife who is not affectionate, is selfish and inconsiderate, complains too much, is quick tempered, conceited, insincere, too critical, narrow minded, argumentative, untruthful. The ten most serious grievances of wives are: the husband is selfish and inconsiderate, untruthful, argumentative, complains too much, is not affectionate, is nervous or impatient, insincere, mismanages his income, criticizes, is not faithful.

The least serious for both are lack of freedom, religious beliefs, swearing, education, tastes in food, difference in age, smoking and drinking.

It is particularly interesting to note that there is not the slightest scientific verification for the psychoanalyst's claim that the Oedipus complex is the cause of marital unhappiness (and everything else). Strong attachment for the parent of opposite sex is as common among those who are happily married as among those who are not. Further, Terman finds that the greatest happiness is found in cases where the marriage partner has no resemblance to his or her parent of opposite sex. If the marriage partner and parent of opposite sex are either of opposite types or resemble each other very closely the marriage tends to be less happy.

There are many points on which Terman's technique, findings and interpretations may be criticized from a technical standpoint. This has already been done in technical psychological journals, and when it comes to being critical of the scientific details of a psychological study, no one can be more devastating than another competent psychologist.

One of the most important contributions of the study is to bring out sharply the tremendous gap which exists between the science of psychology and the psychological method on the one hand, and the methods peculiar to such fields as psychiatry and psycho-analysis on the other. Moreover, the results of Terman's study, as pointed out by Livingston Welch, contradict most of the popular conclusions about marriage reached by the psychiatrists and the psychoanalysts. Terman's study marks a great beginning to truly psychological evaluations of the factors affecting happiness in marriage.

HENRY C. LINK
Psychological Service Center
New York City

✦

ARE THE TROPICS CLOSED TO THE WHITE RACE?

*WHITE Settlers in the Tropics** is an outstanding book. It discusses a problem which is of the utmost importance not only politically and economically, but socially and biologically. Dr. Price has spent years in studying tropical Australia, visiting tropical white settlements and reading practically everything that has been written on the subject. The most notable feature of his book is its highly judicious quality. Dr. Price gathers facts from all sides, balances them carefully, and in every case gives the pros and cons without bias.

*PRICE, A. GRENFELL. *White Settlers in the Tropics*, pp. xiii-311, American Geographical Society, New York. 1939.

The general tenor of Dr. Price's conclusions is that white settlement in the tropics has succeeded in certain marginal areas such as Hawaii, the highlands of Colombia, and especially the plateau of northern Australia. It has never succeeded, however, in the "deep" tropics, that is, in the main portions of the vast tropical areas. Panama, in spite of all that is said about it, does not alter this conclusion. It simply shows that if money enough is spent, a white population can be maintained in reasonable health and a fair degree of activity almost anywhere. The expense, however, is so exhorbitant that little hope is held out at present that the white man will be anything more than a sojourner in the thoroughly tropical parts of the world.

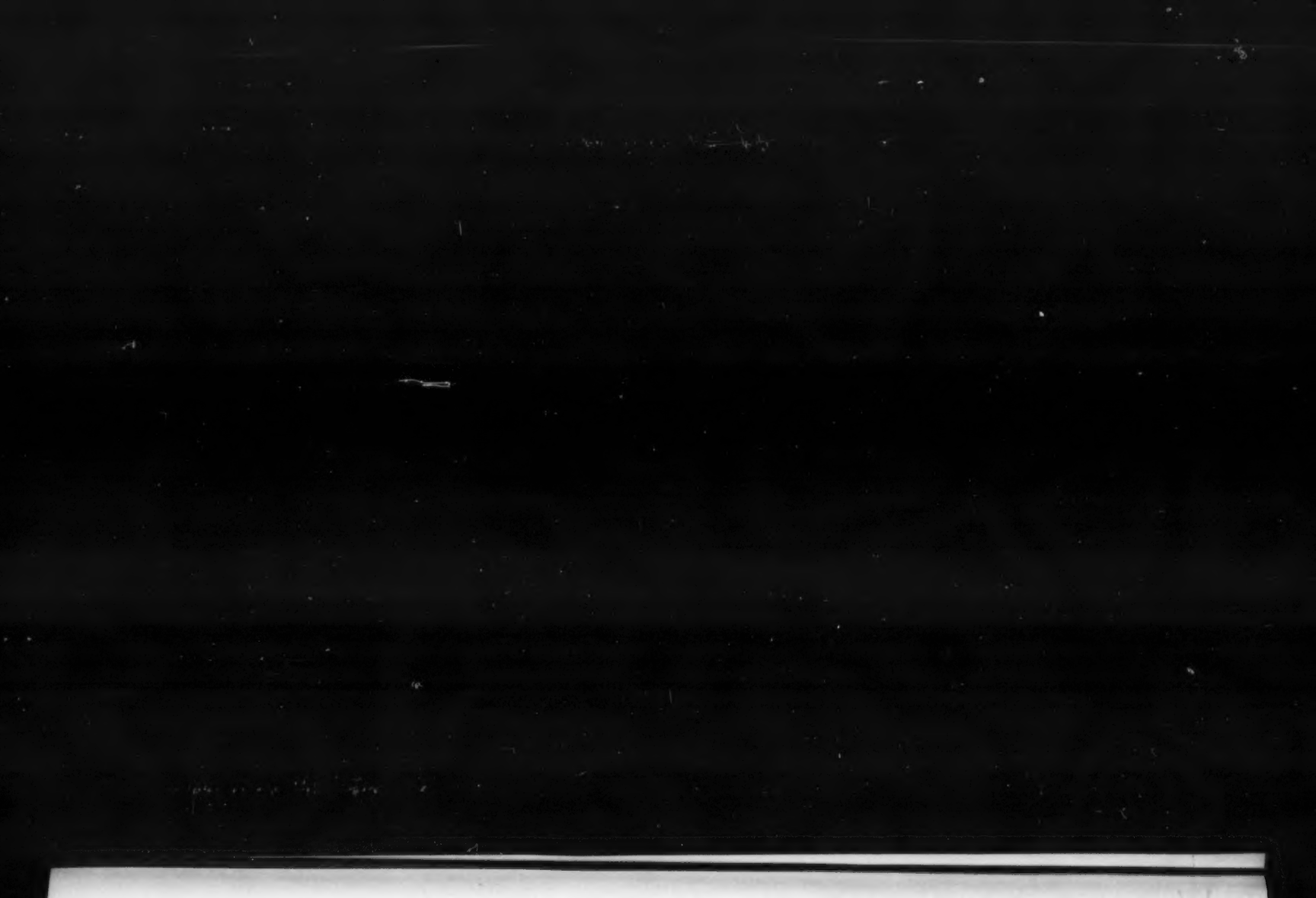
Dr. Price devotes much of his book to an attempt to strike a fair balance between the direct and indirect effects of climate. He is fully convinced of the importance of the direct effect of tropical climates in lessening people's desire to work and in making people susceptible to disease. He lays still more stress, however, upon the social and economic conditions which arise in practically all tropical countries. He shows that one of the main causes of white failure in the tropics has been the native civilizations with which the whites have come in contact. The white man has dominated the natives wherever he has gone, but in the end the native civilization tends to overwhelm him.

This overwhelming is biological even more than social. One of the outstanding biological facts is that the intermixture of races cannot be prevented. Dr. Price cites case after case where a dominantly white population in such places as the West Indies is slowly being replaced by a Negro or Mulatto population. This is by no means due wholly or even mainly to miscegenation. A second factor is that in the tropics, even more than elsewhere, white people tend to have small families; much smaller than those of the colored people. This seems to be a widespread tendency where superior and inferior races live side by side. Another cause of the decline of the white population in tropical countries is the tendency for many of the more energetic young people to migrate to regions where they have better opportunities than at home. This almost always means places with cooler climates. These three biological tendencies, according to Dr. Price, more than anything else make the future of white settlement in the tropics uncertain.

Even in places where no native race is present, Dr. Price is convinced that biological selection takes place among white migrants to the tropics. This has long been one of the most disputed points, but it is one of those on which Dr. Price feels most certain. Tropical Queensland, for example, is not inhabited by average specimens of the British people. Individuals who are sickly, timid, or otherwise unfit for pioneer life do not go there as a rule. Or, if they do go, they do not succeed and in most cases go away. Thus a very real selection takes place. One of the few problems on which Dr. Price allows himself to speculate is the question whether through such selection there may ultimately arise a type of tropical white people appreciably different from the rest of the white race in hereditary and biological make-up.

White Settlers in the Tropics bids fair to stand for a long time as an outstanding authority in its field. It is admirably written and makes interesting reading. It contains a vast number of references together with digests of important opinions about the tropics. An Appendix by Dr. R. G. Stone contains an excellent up-to-date statement as to what is known about the physiological effect of tropical climates. The American Geographical Society, which published the volume, and the Rockefeller Foundation, which financed some of Dr. Price's journeys, are to be congratulated that so valuable a work has been produced.

ELLSWORTH HUNTINGTON
Yale University



SOME INSTITUTIONS
ORDERING
JOURNAL LANTERN SLIDES
Connecticut College
Elizabethtown College
Emory University
Evander Childs High School, N. Y. City
Franklin and Marshall College
Grover Cleveland High School, N. Y. City
Harvard University
Independent School District, Virginia, Minn.
Pennsylvania State College
Purdue University
Rhode Island State College
Rutgers University
San Diego State College
Swiss Federal Institute of Technology
University of Pittsburgh
University of Southern California
University of Wisconsin
Williams College
Wilson College
A list of over 200 slides which may be ordered by number will be sent on request; or order from the Journal, giving volume, page, and figure number. Inquiries solicited regarding slides available to illustrate specific subjects. Price 75c each, $8.00 per dozen.
AMERICAN GENETIC ASSOCIATION
Victor Building
Washington, D .C.

ANNALS OF EUGENICS

THE ONLY JOURNAL PRINCIPALLY DEVOTED TO STATISTICO-GENETIC STUDIES OF INHERITANCE

Edited by R. A. Fisher

(FOUNDED BY KARL PEARSON)

Volume IX, Part II, will contain

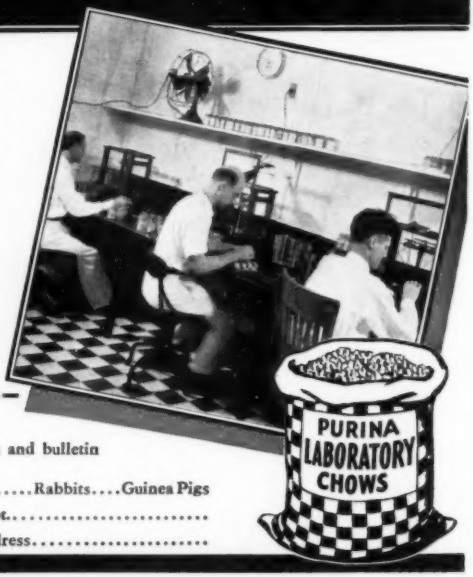
G. L. Taylor and A. M. Prior — R. A. Fisher
Grethe Hartmann — F. Yates — C. D. R. Dawson
M. J. van Uven — D. J. Finney
Reviews

SUBSCRIPTION PRICE 50/- PER VOL.

Address Your Order To
GALTON LABORATORY,
University College, Gower Street, London, W. C. 1.

Quality CONTROL Promotes Accurate Results

THE RIGID quality control methods which are applied to Purina Laboratory Chows help reduce variation in the feeding factor and help promote more accurate results with laboratory animals. Samples of ingredients used in Laboratory Chows are tested in the Purina Analytical Laboratory to insure purity and uniformity, and all ingredients which do not meet the rigid Purina standards are rejected. Only uniform, high-quality ingredients are used in Purina Laboratory Chows!



TEAR HERE

PURINA MILLS,
922 Checkerboard Square, St. Louis, Mo.

Please send sample of diet for following animals and bulletin giving ingredients, cost and feeding directions.

I keep about (No.).....Rats.....Mice.....Dogs.....Rabbits....Guinea Pigs

Name.....Dept.....

Institution.....Address.....